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Review of the genera of algae described

by Stackhouse

by

GEORGE F. PAPENFUSS¹

With few exceptions, algal nomenclature, like that of most other groups of plants, begins with the year 1753, when the first edition of Linnaeus's *Species plantarum* was published. In the second volume of this work, Linnaeus recognized fourteen genera of algae, viz., *Jungermannia*, *Targionia*, *Marchantia*, *Blasia*, *Riccia*, *Anthoceros*, *Lichen*, *Chara*, *Tremella*, *Fucus*, *Ulva*, *Confervaria*, *Byssus* and *Spongia*: and in 1761 in the second edition of his *Fauna suecica* (see also his *Systema naturae*, ed. 12, part 1(2), 1767, pp. 1304-1306) he established the genus *Corallina*, which he regarded as belonging to the animal kingdom, but which later was removed to the algae by S. F. Gray (1821), Decaisne (1842, 1842a) and others.

Although several of the genera which Linnaeus in 1753 regarded as algae actually included species of algae, according to our present concepts of this complex of organisms, only four of his genera, viz., *Chara*, *Fucus*, *Ulva* and *Confervaria*, are currently accepted as genera of algae; and one of them, *Confervaria*, has been reduced to synonymy through the proposed conservation of *Tribonema* Derbès et Solier (1856) against *Confervaria* L. (cf., Int. Rules Bot. Nomencl., ed. 3, 1935, p. 120). Furthermore, it seems likely that *Ulva* L. will ultimately have to be rejected in favor of *Ulva* Thuret (cf., Thuret, 1854; Setchell and Gardner, 1920, p. 261), since there appears to be considerable doubt that Linnaeus had included in his *Ulva* a single species that is still regarded as belonging to this genus.

A few additional genera of algae were erected during the second half of the eighteenth century (e. g., *Padina* by Adanson in 1763) but in general botanists were content to arrange the species under the three classical genera *Fucus*, *Ulva* and *Confervaria*.

Stackhouse was the first one to break away from this custom. He was especially occupied with species of the old genus *Fucus* and his study of them brought him to the realization that this comprehensive genus included a large number of unrelated entities, which he accordingly removed to distinct genera. Of particular interest in this connection are the first two of Stackhouse's three major publi-

¹⁾ The major part of this research was done while the writer held a Guggenheim Fellowship.

cations, viz., the first edition of his *Nereis britannica*, which appeared in fascicles from 1795 to 1801, and his *Tentamen marino-cryptogamicum*, which was published in 1809 in the second volume of *Mémoires de la Société Impériale des Naturalistes de Moscou*. In 1816 he published a second edition of the *Nereis britannica*, in which a number of additional new genera were described, but by that time a few other botanists, notably Lamouroux in France, had come to realize that the Linnean genera of algae were artificial.

In the first edition of his *Nereis britannica*, Stackhouse described as new four genera of marine algae, *Chondrus*, *Sphaerococcus*, *Chorda* and *Codium*, which are still accepted. From the point of view, however, of splitting off genera from the old genus *Fucus*, Stackhouse's *Tentamen marino-cryptogamicum* constituted a much more important contribution, for in this work he established no less than 43 genera of marine algae (including one of lichens). Although five of these genera (*Ascophyllum*, *Bifurcaria*, *Dilsea*, *Gigartina*, *Membranoptera*) are still accepted, the majority of them never received general recognition. Setchell and Gardner (1933, p. 255) by implication attribute this ignorance of the genera of Stackhouse to the fact that the copies of volume two of *Mémoires de la Société Impériale des Naturalistes de Moscou* „... were very nearly completely consumed in the burning of Moscow by Napoleon in 1812.”

Of the early phycologists, Ruprecht (1851) appears to have been the only one who had accepted the genera of Stackhouse, at least those that applied to the plants with which he was concerned. The example that he set was not followed, primarily, it may be supposed, because the genera of Stackhouse had in the intervening period been described and become known under other names; and at that time the principle of priority was not adhered to as strictly as today. Later, when more importance was attached to the rule of priority, O. Kuntze (1891, 1898) revived a large number of old names, including several of those of Stackhouse. This restoration of old generic names by Kuntze probably was the prime factor responsible for the passage of rules governing the conservation of generic names by the Internationaal Botanical Congress.

To a certain extent Stackhouse probably was to blame for the failure of others to take his names seriously, for he himself was peculiarly inconsistent in abiding by them. In many instances he described a genus under a different name than the one he had previously given it, or at times he changed the spelling of the name. In criticizing him, it may be well to remember, however, that in his day the principle of priority was accorded less sanctity than today.

In all, Stackhouse described as new a total of 67 genera of plants which he regarded as marine algae. Of these, one, *Pygmaea* (1809, pp. 60, 95; 1816, pp. x, xii), is a lichen. Of the remaining 66 genera of marine algae, 9 are still accepted, 8 are synonyms of genera described earlier by himself or Linnaeus, one is a later homonym, 47

are synonyms of names that have been conserved or have been proposed for conservation. This leaves one name which invalidates a currently accepted name.

In 1947 the present author proposed for conservation several generic names of algae, including 10 that appeared to be invalidated by names of Stackhouse. In some instances more than one genus was proposed for conservation against one of Stackhouse's genera. This seemed necessary because the genus of Stackhouse could be interpreted as invalidating all the genera in question. Furthermore, precedent for this existed in the approved conservation (*cf.*, Int. Rules Bot. Nomencl., ed. 3, 1935, pp. 87, 88) of both *Furcellaria* Lamouroux (1813) and *Polyides* C. Agardh (1822) against *Fastigiaria* Stackhouse (1809).

The list of names suggested for conservation by the writer was submitted to the Central Committee on Nomenclature of the American Society of Plant Taxonomists for consideration in connection with „proposals regarding amendments and additions to the *Rules* and its various appendices” which it might choose to sponsor on behalf of the Society at the next International Botanical Congress. Several of the names proposed for conservation by the writer were approved by the Committee, but it was wisely pointed out (*cf.*, Camp, W. H., Rickett, H. W. and Weatherby, C. A., 1949, pp. 38, 40) that the conservation of others might not be necessary if certain of the rejected names were satisfactorily typified. Since this is especially true of some of the names proposed for conservation against names given by Stackhouse and since several additional names of Stackhouse appeared to invalidate names currently accepted, I undertook the task of attempting to typify not only those names but all Stackhouse's genera. The results are presented in the annotated list which follows below.

Before passing on to this list it might be pointed out that Stackhouse (1797, p. xxvi) was not only a „pioneer” in the creation of algal genera but appears to have been the first botanist to have arrived at the conclusion that red algae, especially *Fucus coccineus* (= *Placamium coccineum*), possessed two generations in their life history (cystocarpic and tetrasporangial). At first, Turner (1802, pp. 293-294) and others strongly disagreed with Stackhouse on this point, but later Turner (1808, p. 130) remarked about this phenomenon as follows: „Of the zeal, with which the study of Marine Botany has been cultivated during the few years that have elapsed subsequently to the publication of the *Nereis Britannica* [by Stackhouse], and the *Synopsis of the British Fuci* [by Turner], some idea may be formed from the circumstance of the double fruit of *F. coccineus*, being at that time regarded as a curiosity, and as so extraordinary to be in itself almost sufficient to justify the dividing of the plant into two distinct species [Turner had on this account divided it into two varieties in 1802], whereas a similar appearance is now known to be

observable in several of its congeners, and we have every reason to believe, that in the course of time it will also be discovered in many others."

Stackhouse is commemorated by the austral flowering plant genus *Stackhousia* J. E. Smith (1798) of the family Stackhousiaceae. The later homonym of *Stackhousia* Lamouroux (in Leman, 1827) is synonymous with the brown algal genus *Scytothalia* Greville (1830).

Chlorophycophyta.

Codium Stackhouse, 1797, pp. xvi, xxiv.

Only one species, *C. tomentosum* (Huds.) Stackh., was assigned (p. xxiv) to this genus. The genus is still accepted and the species is now known as *C. dichotomum* (Huds.) S. F. Gray (*cf.*, Papenfuss, 1944, p. 338).

Phaeophycophyta.

Abrotanifolia Stackhouse, 1809, pp. 56, 81-82.

Five species were accredited to this genus. All of them are representative of *Cystoseira* Agardh (1820), which name has been conserved against *Gongolaria* Ludwig (1760). The name-bringing, and hence the type, species of *Abrotanifolia* is *Fucus abrotanifolius* L. (= *A. Laeflingii* Stackh., *op. cit.*, p. 81).

Ascophyllum Stackhouse, 1809, pp. 54, 66-67 (as *Ascophylla*).

The single species, *A. laevigatum*, which Stackhouse attributed to this genus is synonymous with *A. nodosum* (L.) Le Jolis (= *Fucus nodosus* L.). *Ascophyllum* is still accepted.

Bifurcaria Stackhouse, 1809, pp. 59, 90.

Only one species, *B. tuberculata* (Huds.) Stackh., was referred to this genus. The generic name is derived from *Fucus bifurcatus* Withering (1796), which is synonymous with *Fucus tuberculatus* Hudson (1778). This genus of Stackhouse is still accepted.

Although Hudson (1778, p. 588), when he described *Fucus tuberculatus* in the second edition of his *Flora anglica*, made no reference to an earlier name given by him to this species, it is obvious that the plant which he had described previously, in the first edition of this work (1762, p. 471), as *Fucus rotundus* is identical with *F. tuberculatus*. The following quotations from the first and second editions of Hudson's *Flora anglica* (with reference to *Fucus rotundus*, 1762, p. 471, and *F. tuberculatus*, 1778, p. 588, respectively, are given in support of this conclusion.

„*Fucus teres* subdichotomus uniformis, ramis obtusis verrucosis.
Fucus kali geniculato similis, non tamen geniculatus R. Syn. 43.
Anglis, round *Fucus*.

Habitat in rupibus marinis prope S. Ives in Cornubia. R. Syn.”

„*Fucus fronde filiformi subdichotoma, ramis obtusis tuberculatis.*
Fucus kali geniculato similis, non tamen geniculatus. R. Syn. 43.
Anglis, tuberculated *Fucus*.

Habitat in *rupibus et saxis submarinis prope St. Ives in Cornubia.*
4 VI-X.”

The plant that has for a long time passed under the name of *Bifurcaria tuberculata* should thus, regretfully, be known as:

Bifurcaria rotunda (Hudson) Papenfuss, comb. nov. (= *Fucus rotundus* Hudson, 1762, p. 471).

Carpoblepta Stackhouse, 1816, pp. x, xii.

This monotypic genus was founded on *Fucus tuberculatus* Hudson and it is thus synonymous with *Bifurcaria* Stackhouse (1809).

Chorda Stackhouse, 1797, pp. xvi, xxiv.

Stackhouse assigned three species to this genus, viz., *Fucus Filum* Linnaeus, *F. flagelliformis* Lightfoot (with a query) and *Chorda thrix* Stackhouse (with doubt, cf., p. xxxvii). In the course of time *Fucus flagelliformis* Lightfoot (1777), which is a later homonym of *Fucus flagelliformis* Müller (1775), was removed to *Gracilaria* Greville (1830), where it is a synonym of *G. confervoides* (L.) Grev. *Chorda thrix* Stackhouse, has been regarded as a synonym of *Chorda Filum* by Greville (1830) or as a variety of this species by Newton (1931) and others.

Through removal of the discordant elements, the genus *Chorda*, which is still accepted, thus came to be typified with *Fucus Filum*.

Ericaria Stackhouse, 1809, pp. 56, 80.

Two species were referred to this genus by Stackhouse, viz., *Eri- caria tamarisca* Stackhouse and *E. Selago* Stackhouse. Both are representative of *Cystoseira* Agardh (1820), which name has been conserved. *Ericaria Selago* is another name for *Fucus selaginoides* L., which is generally regarded as a synonym of *Cystoseira ericoides* (L.) Agardh, and *Ericaria tamarisca* is another name for *Fucus eri- coides* Linnaeus (1763), which is the name-bringing, or type, species of the genus *Ericaria* Stackhouse.

In this connection it might be pointed out that the name-bringing synonym of *Cystoseira ericoides* (L.) Agardh, *Fucus ericoides* Linnaeus (1763), is antedated by the binomial *Fucus tamariscifolius* Hudson (1762, p. 469) and the species should consequently be known as:

Cystoseira tamariscifolia (Hudson) Papenfuss, comb. nov.

Filum Stackhouse, 1809, pp. 60, 94-95.

Stackhouse placed two species in this genus, *Filum chordoides* and *F. glomeratum*; both are synonymous with *Chorda Filum* (L.) Stackhouse (1797). *Chorda* Stackhouse (1797) is still accepted.

Fistularia Stackhouse, 1816, pp. viii, xi.

Three species were placed in this genus, viz., *Fistularia nodosa*, *F. fibrosa* and *F. Mackaii*. One, *F. fibrosa*, is the type of Stackhouse's genus *Monilifera* of 1809 and is representative of *Cystoseira* Agardh (*C. fibrosa*), which name has been conserved, and the other two are representative of *Ascophyllum* Stackhouse (*A. nodosum* and *A. Mackaii*), which genus is still accepted. Since Stackhouse, in his diagnosis of *Fistularia*, referred to his figures of *F. nodosa* as illustrative of the genus, it seems logical to regard this species as the type of the genus; and on this basis *Fistularia* becomes a synonym of *Ascophyllum*.

Gigantea Stackhouse, 1816, pp. viii, xi.

Stackhouse assigned four species to this genus *Gigantea bullata*, *G. simplicifolia*, *G. digitata* and *G. bulbosa*. *G. bullata* and *G. simplicifolia* are representative of *Laminaria saccharina* (L.) Lamouroux, *G. digitata* is representative of *Laminaria digitata* (L.) Lamouroux and *G. bulbosa* is representative of *Saccorhiza polyschides* (Lightf.) Batters (= *S. bulbosa* (Huds.) DelaPylaie). *Laminaria* Lamouroux (1813) and *Saccorhiza* DelaPylaie (1829) have both been conserved. The name-bringing, or type, species of *Gigantea* Stackhouse (*opus. cit.*, p. viii, footnote b) is the *Fuco Giganteo Imperati* of Linnaeus, which is synonymous with *Laminaria saccharina* (L.) Lamouroux. *Gigantea* Stackhouse (1816) is thus synonymous with *Saccharina* Stackhouse (1809) and *Laminaria* Lamouroux (1813).

In this connection it might be mentioned that certain authors attribute the binomial *Laminaria digitata* to Edmondston (1845) but the combination was made by Lamouroux when he created the genus *Laminaria* in 1813 (p. 42).

Halidrys Stackhouse, 1809, pp. 53, 62-65; 1816, pp. viii, xi.

Ten species were placed in this genus by Stackhouse when he created it in 1809. Nine of the names apply to species of *Fucus* Linnaeus (1753) and one to *Pelvetia* Decaisne et Thuret (1845).

The later homonym *Halidrys* Lyngbye (1819) has been conserved against *Siliquarius* Roussel (1806) and *Siliquaria* Stackhouse (1809).

Halidrys Stackhouse (from *hals*, the sea, and *drus*, an oak) is to be typified with *H. vesiculosus* (= *Fucus vesiculosus* L.), which is the *Quercus marina* or sea oak of early writers.

In 1816 Stackhouse had much the same concept of the genus as in 1809. At this time he referred to *Halidrys* eleven species, the majority of which were those that he had assigned to it in 1809.

Herbacea Stackhouse, 1809, pp. 58, 89; 1816, pp. ix, xii.

When he created *Herbacea* in 1809, Stackhouse placed only one species, *H. ligulata*, in the genus. In 1816 he assigned to it a second

species, *H. angustifolia*. Both are synonymous with *Desmarestia ligulata* (Lightf.) Lamouroux. *Desmarestia* Lamouroux (1813) has been conserved against *Hippurina* Stackhouse (1809) and *Hyalina* Stackhouse (1809).

The name *Herbacea* is derived from *Fucus herbaceus* Hudson (1778), which is synonymous with *Fucus ligulatus* Lightfoot (1777).

In this connection it should perhaps be pointed out that the name-bringing synonym, *Fucus herbaceus* Turner (1809, p. 77, pl. 99), of *Desmarestia herbacea* (Turn.) Lamouroux (1813), from the Pacific Coast of North America, is a later homonym of *Fucus herbaceus* Hudson. However, in accordance with Article 69 of the Rules, the plant from the Pacific may still be known as *Desmarestia herbacea* Lamouroux, without the parenthetic Turner.

Hippurina Stackhouse, 1809, pp. 59, 89-90; 1816, pp. ix, xii.

Stackhouse placed two species, *Hippurina aculeata* and *H. caudata*, in this genus. Both are representative of *Desmarestia aculeata* (L.) Lamouroux (1813). *Desmarestia* Lamouroux (1813) has been conserved in part against *Hippurina* Stackhouse.

The name *Hippurina* is derived from *Hippuris setaceus* Barrelier (1714), which is a pre-Linnean synonym of *Fucus aculeatus* Linnaeus (1763).

Hyalina Stackhouse, 1809, pp. 58, 88-89.

Only one species, *Hyalina mutabilis*, was assigned to this genus by Stackhouse. It is synonymous with *Desmarestia viridis* (Müll.) Lamouroux (1813). *Desmarestia* Lamouroux (1813) has been conserved in part against *Hyalina* Stackhouse. Recently, Schmidt (1938) revised the genus *Hyalina* for *Desmarestia viridis* but there seems to be little justification for removing this species from *Desmarestia*.

Iridea Stackhouse, 1816, pp. ix, xii.

Stackhouse placed only one species, *Iridea fluitans*, in this genus. It is synonymous with *Desmarestia viridis* (Müll.) Lamouroux (1813). *Iridea* Stackhouse (1816) is thus identical with *Hyalina* Stackhouse (1809).

The red algal genus *Iridaea* Bory (1826) was recently proposed for conservation by Papenfuss (1947) against the orthographic variant *Iridea* Stackhouse.

Lorea Stackhouse, 1809, pp. 60, 94; 1816, pp. ix, xi.

In 1809, when Stackhouse erected *Lorea* he assigned to it the single species *Fucus elongatus* Linnaeus (1753), which is an older name for *Fucus loreus* Linnaeus (1767a). In 1816 he placed in *Lorea* two species, *L. dichotoma* and *L. inaequalis*, both of which are synonymous with *Fucus elongatus*.

The monotypic *Lorea* Stackhouse is thus synonymous with *Himan-*

thalia Lyngbye (1819), which name has been conserved against *Funicularius* Roussel (1806).

The single species of *Himanthalia* was for a long time known as *H. lorea* (L.) Lyngbye (1819), but in 1931 Setchell made the combination *H. elongata* (L.) Setchell. However, as has been pointed out by Papenfuss (1944), this binomial should be credited to S. F. Gray (1821).

Monilifera Stackhouse, 1809, pp. 57, 82-83.

Stackhouse assigned three species to this genus. All three are representative of *Cystoseira* Agardh (1820), which name has been conserved. The name-bringing, or type, species of *Monilifera* is *M. fibrosa* (Huds.) Stackh. (= *Fucus fibrosus* Hudson), which Turner (1802, p. 93) characterized in part as having „vesiculis subrotundis moniliformibus innatis.”

In 1816 Stackhouse placed *Monilifera fibrosa* along with *Fucus nodosus* Linnaeus and *F. Mackaii* Turner in his newly created genus *Fistularia*.

Musaefolium Stackhouse, 1809, pp. 53, 66 (as *Musaefolia*).

The single species, *M. esculenta* (= *Fucus esculentus* L.), which Stackhouse assigned to this genus is synonymous with *Alaria esculenta* (L.) Greville. *Alaria* Greville (1830) has been conserved against *Musaefolium* Stackhouse (1809) and *Orgyia* Stackhouse (1816).

Orgyia Stackhouse, 1816, pp. viii, xi.

Stackhouse placed two species in this genus, viz., *Fucus esculentus* Linnaeus (1767b) and *F. tetragonus* Goodenough et Woodward (1797). Both are representative of *Alaria esculenta* (L.) Greville. *Orgyia* is thus synonymous with the monotypic *Musaefolium* Stackhouse (1809); and, as has been mentioned above, both these genera of Stackhouse have been rejected in favor of the conserved genus *Alaria* Greville (1830).

Phryganella Stackhouse, 1816, pp. ix, xi.

Six species were placed in this genus by Stackhouse, including the type species of his genera *Abrotanifolia* and *Ericaria* of 1809. *Phryganella* thus supplants *Abrotanifolia* and *Ericaria*, and all its species, like those of *Abrotanifolia* and *Ericaria*, are representative of *Cystoseira* Agardh (1820), which name has been conserved.

Polypodoidea Stackhouse, 1809, pp. 96, 97.

Stackhouse assigned only one species, *Fucus membranaceus* Stackhouse (1801), to this genus. The generic epithet is derived from *Fucus polypodioides* Desfontaines (1800), which is an older name for this species. *Polypodoidea* Stackhouse is synonymus with *Dictyopteris* Lamouroux (1813), which genus has been proposed for con-

servation (Int. Rules Bot. Nomencl., ed. 3, 1935) against *Neurocarpus* Weber et Mohr (1805).

***Polyschidea* Stackhouse, 1809, pp. 53, 65-66.**

Two species were referred to this genus by Stackhouse. One is representative of *Laminaria* Lamouroux (1813) and the other of *Saccorhiza* DelaPylaie (1829). The name-bringing, or type, species of the genus is *Fucus polyschides* Lightfoot (1777), which is the type and only species of the genus *Saccorhiza* DelaPylaie. *Saccorhiza* has been conserved against *Polyschidea*.

***Saccharina* Stackhouse, 1809, pp. 53, 65.**

Stackhouse placed two species in this genus, viz., *Saccharina plana* and *S. bullata*. Both are representative of *Laminaria saccharina* (L.) Lamouroux (1813). *Laminaria* Lamouroux has been conserved in part against *Saccharina* Stackhouse.

***Siliquaria* Stackhouse, 1809, pp. 54, 67; 1816, pp. viii, xi.**

In 1809, when he created the genus, Stackhouse placed two species in *Siliquaria*, and in 1816 he assigned to it three species. All of them are representative of *Halidrys siliquosa* (L.) Lyngbye. *Halidrys* Lyngbye (1819) has been conserved against *Siliquarius* Roussel (1806) and *Siliquaria* Stackhouse (1809).

Rhodophycophyta.

***Amphibia* Stackhouse, 1809, pp. 58, 89.**

Only one species, *Amphibia scorpioides* (Huds.) Stackh., was referred to this genus. The generic name is derived from *Fucus amphibius* Hudson (1778), which is synonymous with *Fucus scorpioides* Hudson (1762).

Bostrychia Montagne (1838) has been conserved against *Amphibia* Stackhouse (1809).

It might be noted that the name-bringing synonym of *Bostrychia scorpioides* (Huds.) Montagne, *Fucus scorpioides*, is usually attributed to Gmelin (1768). However, the species was first described under this epithet by Hudson (1762, p. 471), and he was credited with the name by Gmelin.

***Atomaria* Stackhouse, 1816, pp. x, xii.**

Stackhouse assigned two species to this genus, namely, *Atomaria dentata* (L.) Stackh. and *A. angustifolia* Stackh. (*nomen nudum*). Both are representative of *Fucus dentatus* Linnaeus (1767b, p. 135). The generic name is derived from *Fucus Atomarius* Gmelin (1768, p. 125), which is synonymous with *Fucus dentatus* L.

Atomaria Stackhouse (1816) is a synonym of *Fimbriaria* Stackhouse (1809) and the latter epithet has been rejected in favor of the conserved name *Odonthalia* Lyngbye (1819).

Bifida Stackhouse, 1809, pp. 95, 97.

This genus was established by Stackhouse upon two species, *Bifida divaricata* Stackh. and *B. subpalmata* Stackh., both of which are representative of *Rhodophyllum bifida* (Good. et Woodw.) Kützing. *Rhodophyllum* Kützing (1847) has been conserved against *Bifida* Stackhouse (1809).

Although the generic name *Bifida* is derived from *Fucus bifidus* Hudson (1778), which is synonymous with *Rhodymenia Palmetta* (Esp.) Greville (1830), Stackhouse, like Goodenough and Woodward (1797), Turner (1802) and certain other early authors, erroneously associated this binomial of Hudson with the plant that is currently known as *Rhodophyllum bifida*. *Bifida* Stackhouse is thus correctly synonymized with *Rhodophyllum* Kützing.

This early mistake in the interpretation of *Fucus bifidus* Hudson has, as is usually the case, been responsible for a certain amount of nomenclatural confusion, which, in this instance, has persisted down to the present.

The name-bringing synonym of *Rhodophyllum bifida* is *Fucus bifidus* Goodenough et Woodward (1797). This name is invalid, however, for two reasons: first, Goodenough and Woodward did not describe the species as new but called it *Fucus bifidus* Hudson (1778) and second, the binomial *Fucus bifidus* had already been used for two totally different plants. Gmelin (1768) first described under this name the laminarialean plant now known as *Arthrothamnus bifidus* (Gmel.) Ruprecht, and Hudson (1778) next employed this epithet, as has already been mentioned, for the red alga which is now known as *Rhodymenia Palmetta* (Esper) Greville.

It is thus necessary that another specific name be found for *Rhodophyllum bifida*. The oldest valid name appears to be the one which was given to this plant by Stackhouse (1809, p. 97) when he described the genus *Bifida*, viz., *B. divaricata*, and the species should accordingly be known as:

***Rhodophyllum divaricata* (Stackhouse) Papenfuss, comb. nov.**

Capillaria Stackhouse, 1809, pp. 58, 87-88; 1816, pp. x, xii.

When Stackhouse established this genus in 1809 he assigned to it six species, representative of the following six genera as currently accepted: *Gloiosiphonia* Carmichael (*in* Berkeley, 1833), *Chondria* Agardh (1817), *Bonnemaisonia* Agardh (1822), *Sporochnus* Agardh (1817), *Naccaria* Endlicher (1836) and *Cystoclonium* Kützing (1843). The name-bringing, or type, species of *Capillaria* is *Fucus capillaris* Hudson (1778) and since this species is also the type of *Gloiosiphonia* Carmichael, it becomes necessary that the latter genus be considered for conservation. In 1816, Stackhouse included in *Capillaria* the majority of the species that he assigned to it in 1809, although he excluded from it the type species, *Fucus capillaris* Hudson.

Chondrus Stackhouse, 1797, pp. xv, xxiv.

This genus of Stackhouse is still accepted. It has been typified by Schmitz (1889) with *Chondrus crispus* (L.) Stackhouse. However, the name-bringing synonym of this plant, *Fucus crispus* Linnaeus (1767b), is illegitimatized by the homonym of *Fucus crispus* Hudson (1762), which is regarded by Turner (1802, p. 216) as synonymous with *Fucus rubens* Linnaeus (1753, p. 1162), or *Phyllophora rubens* (L.) Greville as it is now known. The species appears to have been described for the first time by Hudson (1762, p. 472) under the binomial *Fucus filiformis* (cf., Turner, 1819, p. 51, who received one of Hudson's specimens of this plant). The specific epithet of Hudson (*filiformis*) can not be transferred to *Chondrus*, however, because Okamura and Segawa (in Segawa, 1935, p. 81) have described a species of *Chondrus* under the name *C. filiformis*. According to Article 69 of the Rules, the plant from the North Atlantic may thus retain the name of *Chondrus crispus* Stackhouse, without the parenthetic Linnaeus.

Ciliaria Stackhouse, 1809, pp. 54, 70-71.

Five species were placed in this genus. Four of them are representative of *Calliblepharis* Kützing (1843), which genus has been conserved against *Ciliaria*, and the fifth belongs to *Ptilota* Agardh (1817). *Fucus ciliatus* Hudson (1762), now known as *Calliblepharis ciliata* (Huds.) Kütz., is the name-bringing, or type, species of *Ciliaria*.

Clavaria Stackhouse, 1816, pp. x, xii.

Clavaria Stackhouse was established upon *Fucus caespitosus* Stackhouse (1801) and was merely another name for *Clavatula* Stackhouse (1809), a monotypic genus based upon the same species. *Clavaria* Stackhouse illegitimatizes the fungal genus *Clavaria* Fries (1821), which Doty (1948) has proposed for conservation.

Clavatula Stackhouse, 1809, pp. 95, 97.

This genus was based on the single species *Fucus caespitosus* Stackhouse (1801, p. 59, pl. 12). The generic name is derived from *Fucus clavatus* Lamouroux (1805, p. 22, pl. 22, figs. 1, 2), which is a synonym of *F. caespitosus*. Both these specific epithets are synonyms of *Fucus pusillus* Stackhouse (1801, p. 17), which plant is now known as *Gelidium pusillum* (Stackh.) Le Jolis (1863). *Clavatula* Stackhouse as well as *Cornea* Stackhouse (1809) invalidates *Gelidium* Lamouroux (1813), which name has accordingly been proposed for conservation by Papenfuss (1947).

Cornea Stackhouse, 1809, pp. 57, 83-84.

Stackhouse placed six species in this genus. Five of them are representative of *Gelidium* Lamouroux (1813) and one belongs to

Pterocladia J. Agardh (1852). Inasmuch as the generic name *Cornea* is derived from *Fucus corneus* Hudson (1762), which is the name-bringing synonym of *Gelidium corneum* (Huds.) Lamouroux (1813), and since the genus is largely representative of *Gelidium*, there is little question that *Cornea* Stackhouse invalidates *Gelidium* Lamouroux. As has been mentioned above, under *Clavatula* Stackhouse, *Gelidium* has been proposed for conservation by Papenfuss (1947). In the same article, Papenfuss also proposed *Pterocladia* J. Agardh for conservation against *Cornea*, as represented by *C. capillacea* (Gmelin) Stackh., but with the proper typification of *Cornea* with *Fucus corneus* Hudson this is no longer necessary.

It is to be noted that *Cornea capillacea*, which is based on *Fucus capillaceus* Gmelin (1768, p. 146, pl. 15, fig. 1) and is now known as *Pterocladia capillacea* (Gmel.) Bornet et Thurnet (1876), was first described by Hudson (1762, p. 474) as *Fucus pinnatus* (*cf.* also Hudson, 1778, p. 586) and the species should accordingly be known as:

***Pterocladia pinnata* (Huds.) Papenfuss, comb. nov.**

Coronopifolia Stackhouse, 1809, pp. 57, 85-86; 1816, pp. ix, xii.

When Stackhouse established this genus in 1809, he based it on a single species, which he called *Coronopifolia cartilaginea*. In 1816, when he treated the genus again, he still placed in it only one species, which he at that time called *C. vulgaris*. Both these binomials are synonymous with *Fucus coronopifolius* Goodenough et Woodward (1797), the specific epithet of which was used by Stackhouse to make the generic name *Coronopifolia*. *Fucus coronopifolius* has been designated by Greville (1730), Schmitz (1889) and Kylin (1932) as the type species of *Sphaerococcus* Stackhouse (1797). *Coronopifolia* is thus synonymous with *Sphaerococcus*, which genus is still accepted.

Vidalia Lamouroux has been conserved against *Coronopifolia* Stackhouse but that was unnecessary.

Dasyphylla Stackhouse, 1816, pp. ix, xi.

Stackhouse placed five species in this genus. They are representative of *Chondria* Agardh (1817), *Lomentaria* Lyngbye (1819) and *Gastroclonium* Kützing (1843). The name-bringing, and hence the type, species of *Dasyphylla* is *Fucus dasyphyllus* Woodward (= *D. Woodwardii* Stackh.); and since this species is representative of the genus *Chondria*, it follows that *Dasyphylla* Stackhouse invalidates *Chondria* Agardh.

Papenfuss (1947) has proposed *Chondria* Agardh for conservation against *Dasyphylla* Stackhouse and *Kaliformis* Stackhouse (1809). He has also proposed *Dasyphila* O. G. Sonder (1845) for conservation against *Dasyphylla* Stackhouse.

Dilsea Stackhouse, 1809, pp. 55, 71.

This genus was established by Stackhouse upon the single species

Dilsea edulis Stackhouse. It is still accepted and is tooay credited with two additional species, *D. californica* (J. Ag.) O. Kuntze (1891, p. 892) and *D. integra* (Kjellm.) Rosenvinge.

It is strange, as has been pointed out by Turner (1809, p. 113), that this species during early times should have been the source of so much confusion with *Fucus palmatus* (= *Rhodymenia palmata*). It is to be noted that the name-bringing synonym of *Dilsea edulis* is *Fucus edulis* Stackhouse (1801, p. 57). However, the latter name is invalid for two reasons: first, a plant from the East Indies had previously been described under the same name by Gmelin (1768, p. 113) and second, the species had been described earlier as *Fucus carnosus* by Schmidel (1794, p. 76) and as *Fucus Lactuca* by Esper (1799, p. 129, pl. 64). Esper's illustration (*op. cit.*, pl. 76) of *Fucus carnosus* is based on one of Schmidel's specimens.

With respect to the observations of Schmidel upon this species Turner (1809, p. 113) remarks: „The accurate and indefatigable Schmidel appears to have been the earliest botanist who well understood it: he has given an excellent account of it in his *Tour through France*, where, in the neighbourhood of Dieppe, he had an opportunity of observing it abundantly in a recent and growing state.” Turner adds, furthermore, that the fructification of *Fucus carnosus* „was first discovered by Dr. Weber and Dr. Mohr in the specimens gathered by Schmidel, and is here represented [pl. 114] from one of the same, for which I am indebted to the kindness of the President von Schreber.” There appears to be little question therefore that the binomial *Dilsea edulis* Stackhouse (1809) should be supplanted with *Dilsea carnosa* (Schmidel) O. Kuntze (1898, p. 404), a combination which has been completely overlooked.

Epiphylla Stackhouse, 1816, pp. x, xii.

Only one species, *Fucus rubens* Linnaeus, was assigned to this genus by Stackhouse. The generic name is derived from *Fucus epiphyllus* Müller, which is a synonym of *Fucus rubens* Linnaeus.

Epiphylla is synonymous with *Prolifera* Stackhouse (1809, pp. 56, 77-78) which was also based on *Fucus rubens* Linnaeus, and both these genera are in turn synonymous with *Phyllophora* Greville (1830), which name has been conserved against *Membranifolia* Stackhouse (1809).

Fastigiaria Stackhouse, 1809, pp. 59, 90-92; 1816, pp. viii, xi.

Five species were placed in this genus by Stackhouse when he erected it in 1809. One of them, *Fastigiaria rotunda*, is representative of *Polyides* Agardh, viz., *P. rotundus*; three *F. Linnaei*, *F. lumbicalis* and *F. furcellata*, are representative of *Furcellaria* Lamouroux, and all three are synonymous with *F. fastigiata*; and the remaining species, *Fastigiaria capitata*, is a *nomen nudum*.

In 1816 Stackhouse's concept of *Fastigiaria* was much the same as

in 1809. Both *Polyides* Agardh (1822) and *Furcellaria* Lamouroux (1813) have been conserved against *Fastigiaria* Stackhouse. Which of these two genera was actually invalidated by *Fastigiaria*, and hence in need of conservation, depends upon the identity of *Fucus fastigiatus* Linnaeus (1753, p. 1162), or *Fastigiaria Linnaei* Stackhouse, which is the name-bringing and thus the type species of *Fastigiaria*. Since the time of Turner's writings (1802, p. 315; 1808, p. 10) it has been the custom to synonymize *Fucus fastigiatus* L. with *Polyides rotundus* (Gmelin) Greville (= *Fucus rotundus* Gmelin, 1768, p. 110, pl. 6, fig. 3). This is because Turner (1802, p. 315) believed that Linnaeus's description of *Fucus fastigiatus* was essentially based on the plant that is currently known as *Polyides rotundus* rather than upon the one that passes under the name *Furcellaria fastigiata* (Hudson) Lamouroux. However, the fact that Linnaeus in his original description of *Fucus fastigiatus* gave the Baltic as the habitat of the species and in his *Flora suecica* (ed. 2, 1755, p. 432) mentioned as localities in the Baltic the provinces of Aland and Gotland would seem to indicate with reasonable certainty that he was dealing with *Furcellaria fastigiata* rather than *Polyides rotundus*. According to Levring (1940), *Furcellaria fastigiata* is common and widely distributed in the Baltic whereas *Polyides rotundus* is an extremely rare alga whose known distribution in the inner Baltic does not extend beyond Hanö in the province of Blekinge in southern Sweden.

Until proved wrong, it thus appears more logical to regard *Fastigiaria* as synonymous with *Furcellaria* and to accept the binomial *Fucus fastigiatus* L. (not *F. fastigiatus* Hudson, 1762, which does not exist) as the name-bringing synonym of *Furcellaria fastigiata* Lamouroux.

In regard to the generally accepted name-bringing synonym, *Fucus rotundus* Gmelin (1768, p. 110), of *Polyides rotundus*, it should be pointed out that Gmelin did not describe this species as new but misidentified it with *Fucus rotundus* Hudson (1762, p. 471), which, as has been pointed out in another place in the present article (under *Bifurcaria* Stackhouse), is an older name for *Fucus tuberculatus* Hudson (1778, p. 588), the name-bringing synonym of *Bifurcaria tuberculata*. The plant that has passed under the name of *Polyides rotundus* (Gmelin) Greville should thus apparently be known as:

Polyides caprinus (Gunnerus) Papenfuss, comb. nov. (= *Fucus caprinus* Gunnerus, 1766, p. 96).

Fimbriaria Stackhouse, 1809, pp. 95, 96.

Stackhouse assigned two species, *Fimbriaria dentata* and *F. Reidii*, to this genus. Both are representative of *Odonthalia dentata* (L.) Lyngbye (1819). *Odonthalia* Lyngbye (1819) has been conserved against *Fimbriaria* Stackhouse.

Fimbriaria is an older name for the genus which Stackhouse in 1816 described under the name *Atomaria*.

Flagellaria Stackhouse, 1809, pp. 59, 92-93; 1816, pp. ix, xi.

When Stackhouse erected this genus in 1809 he placed in it six species. Four of them, *Flagellaria confervoides*, *F. verrucosa*, *F. gracilis* and *F. simplex*, are representative of *Gracilaria* Greville (1830), viz., *G. confervoides*; one, *F. flagelliformis*, is representative of *Chordaria* Agardh (1817), viz., *C. flagelliformis*; and one *F. pliata*, is a species of *Ahnfeltia* Fries (1835), viz., *A. plicata*.

In 1816, when Stackhouse gave a second treatment of *Flagellaria*, he placed in it four species. Two of them, *F. Filum* and *F. thrix*, are representative of *Chorda* Stackhouse (1797), viz., *C. Filum*, and two, *F. flagelliformis* and *F. longissima*, are synonymous with *Chordaria flagelliformis*.

The generic name *Flagellaria* Stackhouse is probably derived from *Fucus flagellaris* Esper (1800, p. 193), which species Turner (1809, p. 30) regards as synonymous with *Fucus confervoides* (or *Gracilaria confervoides* as it is now known), although De Toni (1900, p. 438) places it in the synonymy of *Gracilaria compressa*.

Flagellaria Stackhouse (1809) may thus be considered as synonymous with *Gracilaria* Greville (1830), which name has been conserved against *Ceramianthemum* Donati. Furthermore, Linnaeus (1753) had previously given the name *Flagellaria* to a genus of flowering plants.

It may be noted that the genus *Gracilaria* has been typified by both Schmitz (1889, p. 443) and Kylin (1932, p. 58) with *G. confervoides* (L.) Greville. However, the name-bringing synonym of this binomial, viz., *Fucus confervoides* Linnaeus (1763, p. 1629), is a later homonym of *Fucus confervoides* Hudson (1762, p. 474). Moreover, the species was apparently described for the first time by Hudson (1762, p. 470) as *Fucus verrucosus* and it should accordingly be known as:

***Gracilaria verrucosa* (Huds.) Papenfuss, comb. nov.**

Fuscaria Stackhouse, 1809, pp. 59, 93-94.

This monotypic genus was based on *Fucus subfuscus* Woodward (= *Fuscaria variabilis* Stackhouse). *Fuscaria* Stackhouse is an older name for *Rhodomela* Agardh (1822), but the latter name has been conserved against the former.

As is well known, the species of *Rhodomela* intergrade to an extreme degree. The North Atlantic complex of this genus is treated by some authors as representative of a single species and by others as comprising two species. Depending upon the author, one or two of the following three names have been assigned to the plants from this region: *R. subfusca* (Woodw.) Ag (= *Fucus subfuscus* Woodward, 1791), *R. lycopodioides* (L.) Ag. (= *Fucus lycopodioides* Linnaeus, 1767), and *R. virgata* Kjellman (1883). Whatever the status may be of the North Atlantic species of *Rhodomela*, a member of the genus apparently was described for the first time by Hudson (1762, p. 474)

as *Fucus confervoides*; and as has been pointed out under *Flagellaria* this binomial of Hudson invalidates *Fucus confervoides* Linnaeus (1763, p. 1629), which is the name-bringing synonym of *Gra-cilaria confervoides*.

Gigartina Stackhouse, 1809, pp. 55, 74-75; 1816, pp. x, xii.

When Stackhouse in 1809 established this genus he included in it only one species, *Gigartina pistillata* (Gmelin) Stackhouse. The generic name is derived from *Fucus gigantinus* Linnaeus (1767), which is synonymous with *Fucus pistillatus* Gmelin (1768). In 1816, Stackhouse still regarded *Gigartina* as a monotypic genus, but at that time he called the species *G. Laeflingii* instead of *G. pistillata*.

Hydrolapathum Stackhouse, 1809, pp. 54, 67-69 (as *Hydrolapatha*).

Stackhouse assigned six species to this genus, viz., *Fucus sanguineus* Hudson (1762, p. 475), *F. sinuosus* Goodenough et Woodward (1797, p. 111), *Hydrolapatha quercifolia* Stackhouse (*op. cit.*, p. 68), *F. Hypoglossum* Woodward (1794), *F. hypoglossoides* Stackhouse (1801, p. 76) and *F. ruscifolius* Turner (1802). These species belong to the following four genera as currently recognized: *Delesseria* Lamouroux (1813), which includes *Fucus sanguineus*; *Phycodrys* Kützing (1843), which includes *F. sinuosa* and *Hydrolapatha quercifolia* (both as synonyms of *P. sinuosa*); *Hypoglossum* Kützing (1843), which includes *F. Hypoglossum* and *F. hypoglossoides* (both as synonyms of *H. Woodwardii*); and *Apoglossum* J. Agardh (1898), which includes *F. ruscifolius*.

The generic name *Hydrolapathum* Stackhouse is derived from and the genus is accordingly to be typified with the „*Fucus.... Lapathi sanguinei....*” of early writers, which is also the name-bringing synonym of *Fucus sanguineus* Hudson (1762). *Hydrolapathum* Stackhouse is thus synonymous with *Delesseria* Lamouroux, which has been typified with *F. sanguineus* by Kützing (1843), Schmitz (1889) and Kylin (1924).

Delesseria Lamouroux (1813) has been conserved against *Hydrolapathum* Stackhouse (1809) and *Membranoptera* Stackhouse (1809). However, *Membranoptera*, which is based on *M. alata*, is currently recognized as a genus distinct from *Delesseria*.

In regard to *Fucus sanguineus*, it is to be noted that this species was described for the first time by Hudson (1762, p. 475) — not by Linnaeus (1767a, p. 136), who is usually credited with the species but who himself recognized Hudson as the author.

Hydrophyllum Stackhouse, 1816, pp. viii, xi, (as *Hydrophylla*).

This genus of Stackhouse included the type species of his genus *Hydrolapathum* of 1809, viz., *Fucus sanguineus* Hudson, and it must therefore be regarded as synonymous with *Hydrolapathum*, which in turn is synonymous with the conserved genus *Delesseria* Lamou-

roux (1813). In addition to *Fucus sanguineus*, Stackhouse credited *Hydrophyllum* with *Fucus sinuosus* Goodenough et Woodward, which is the type species of *Phycodrys* Kützing (1843).

Hymenophyllum Stackhouse, 1816, pp. ix, xi (as *Hymenophylla*).

Seven species were placed in this genus by Stackhouse. They are representative of *Nitophyllum* Greville (1830), *Callophyllis* Kützing (1843), *Cryptopleura* Kützing (1843), *Rhodophyllum* Kützing (1847) and *Rhodymenia* Greville (1830).

Hymenophyllum included the type species, *Fucus laceratus* Gmelin (1768), of *Papyracea* Stackhouse (1809, pp. 56, 76) and must accordingly be regarded as synonymous with the latter name, which Stackhouse ignored in 1816.

As is pointed out elsewhere in the present article, *Papyracea* Stackhouse invalidates the currently accepted genus *Cryptopleura* Kützing, which is also based on *Fucus laceratus*.

Hypophyllum Stackhouse, 1816, pp. ix, xii (as *Hypophylla*).

Stackhouse assigned six species to this genus, including several of those that he in 1809 had referred to *Hydrolapathum*. The species are representative of *Membranoptera* Stackhouse (1809), *Hypoglossum* Kützing (1843) and *Apoglossum* J. Agardh (1898). But inasmuch as *Hypophyllum* included the type, *Fucus alatus* Hudson (1762), of *Membranoptera* it must be regarded as synonymous with the latter genus, which Stackhouse disregarded in his work of 1816.

Kaliformia Stackhouse, 1816, pp. ix, xii.

This genus of Stackhouse replaced to a certain extent his *Kaliformis* of 1809. It contained five species which are representative of *Chylocladia* Greville (in Hooker, 1833) *Catenella* Greville (1830) and *Gelidium* Lamouroux (1813). Inasmuch as the name is derived from *Fucus kaliformis* Goodenough et Woodward, this species must be regarded as the type. *Kaliformia* is thus synonymous with *Kaliformis* Stackhouse (1809), which in turn is synonymous with the conserved genus *Chylocladia* Greville.

Kaliformis Stackhouse, 1809, pp. 56, 78-79.

Six species were referred to this genus by Stackhouse. One of them, *K. verticillatus*, is representative of *Chylocladia* Greville (in Hooker, 1833), viz., *C. verticillata* (Lightf.) Bliding; two, *K. articulatus* and *K. clavellosus*, are species of *lomentaria* Lyngbye (1819), viz., *L. articulata* (Huds.) Lyngbye and *L. clavellosa* (Turn.) Gaillon; one, *K. dasypyllus*, is a species of *Chondria* Agardh (1817), viz., *C. dasypylla* (Woodw.) Agardh; one, *K. obtusus*, is a species of *Laurencia* Lamouroux (1813), viz., *L. obtusa* (Huds.) Lamouroux; and one, *K. Opuntia*, is a species of *Catenella* Greville (1830), viz., *C. repens* (Lightf.) Batters.

In 1947, Papenfuss proposed *Catenella* Greville and *Lomentaria* Lyngbye for conservation against *Kaliformis* Stackhouse, but with the proper typification of *Kaliformis* the necessity of this is removed. The name-bringing, and hence the type, species of *Kaliformis* is *Fucus kaliformis* Goodenough et Woodward (1797), and since this entity is a synonym of the type species of *Chylocladia* Greville (in Hooker, 1833), viz., *C. verticillata* (Lightf.) Bliding, it follows that *Kaliformis* is a synonym of *Chylocladia*; and this genus has been conserved against *Sedoidea* Stackhouse (1809), although, as has been pointed out by Papenfuss (1947, p. 11), the latter genus did not invalidate *Chylocladia*.

Mammillaria Stackhouse, 1809, pp. 55, 74.

This genus received two species, *M. expansa* and *M. echinata*, both of which are synonyms of *Fucus mamillosus* Goodenough et Woodward (1797), which epithet was used in the coining of the generic name.

Since *Fucus mamillosus* has been shown to be a species of the currently accepted genus *Gigartina* Stackhouse (1809), viz., *G. mamillosa* (Good. et Woodw.) J. Agardh, it follows that *Mammillaria* Stackhouse is synonymous with *Gigartina*.

Membranifolia Stackhouse, 1809, pp. 55, 75-76.

Four species were included in this genus by Stackhouse. Two of them, *M. lobata* and *M. fimbriata*, are representative of *Phyllophora* Greville (1830), viz., *P. membranifolia* (Good. et Woodw.) J. Agardh; one, *M. lacera*, is a species of *Chondrus* Stackhouse (1797), viz., *C. crispus* Stackhouse; and one, *M. Palmetta*, probably is representative of *Rhodymenia* Greville (1830), viz., *R. Palmetta* (Esp.) Greville.

The name-bringing and hence the type species of *Membranifolia* is *Fucus membranifolius* Goodenough et Woodward (1797); and since this entity is now regarded as a species of *Phyllophora*, *Membranifolia* Stackhouse (1809) becomes a synonym of *Phyllophora* Greville (1830), which name has been conserved against *Membranifolia*.

Membranoptera Stackhouse, 1809, pp. 57, 85.

Membranoptera was based on three entities, *M. alata*, *M. angustifolia* and *M. costata*, all of which are representative of *Fucus alatus* Hudson (1762). The genus *Membranoptera*, with the type *M. alata* (Huds.) Stackhouse, is still accepted.

Nereidea Stackhouse, 1809, pp. 58, 86; 1816, pp. ix, xii.

When this genus was established by Stackhouse in 1809, he assigned to it two species, *N. coccinea* and *N. plocamium*, both of which are synonyms of *Plocamium coccineum* (Huds.) Lyngbye (= *Fucus*

coccineus Hudson, 1778, p. 586; *Fucus plocamium* Gmelin, 1768, p. 153, pl. 16, fig. 1).

Plocamium Lamouroux (1813), which has been typified by Schmitz (1889) and Kylin (1932) with *P. coccineum*, has been conserved against *Nereidea* Stackhouse (1809).

A second treatment of *Nereidea* was given by Stackhouse in 1816. However, at this time the genus had nothing but the name in common with the genus of 1809. *Nereidea* of the 1816 treatment is synonymous with *Cornea* Stackhouse (1809) and *Gelidium* Lamouroux (1813).

Osmundea Stackhouse, 1809, pp. 56, 79-80.

Osmundea received three species of which two, *O. expansa* and *O. pinnatifida*, and possibly also the third, *O. filiformis*, are representative of *Laurencia* Lamouroux (1813). *Fucus Osmunda* Gmelin (1768, p. 155), which is now known as *Laurencia pinnatifida* var. *Osmunda*, furnished the generic name *Osmundea*. *Laurencia* was recently proposed for conservation against *Osmundea* by Papenfuss (1947).

In regard to *Laurencia pinnatifida*, it may be noted that Gmelin (1768, p. 156) is usually cited as the author of the species (as *Fucus pinnatifidus*). The plant was, however, described for the first time under the latter binomial by Hudson (1762, p. 473), and Gmelin had credited Hudson with the species.

Palmaria Stackhouse, 1809, pp. 54, 69.

Three species were placed in *Palmaria* by Stackhouse. Two of them, *P. expansa* and *P. lanceolata*, and possibly also the third, *P. olivacea*, are synonymous with the name-bringing entity, *Fucus palmatus* Linnaeus (1753, p. 1162) or *Rhodymenia palmata* (L.) Greville as it is now known.

Rhodymenia Greville (1830) has been conserved against *Palmaria* Stackhouse.

Papyracea Stackhouse, 1809, pp. 56, 76-77.

This genus received five species. Three of them, *P. lacerata*, *P. pumila* and *P. elongata*, are representative of *Cryptopleura* Kützing (1843), viz., *C. lacerata* (Gmel.) Kütz.; one, *P. laciniiata*, is a species of *Callophyllis* Kützing (1843), viz., *C. laciniiata* (Huds.) Kütz.; and one, *P. punctata*, is a species of *Nitophyllum* Greville (1830), viz., *N. punctatum* (Stackh.) Grev.

Papyracea Stackhouse has for a long time been regarded as a synonym of *Nitophyllum* Greville, with which name *Cryptopleura* Kützing has also been synonymized; and *Nitophyllum* has been conserved against *Scutarius* Roussel (1806) and *Papyracea*.

Inasmuch as the name-bringing entity of *Papyracea* is Goodenough and Woodward's (1797, p. 155) var. β *papyraceus* of *Fucus laceratus* and since this variety is a synonym of *Fucus laceratus*, which is also

the type of *Cryptopleura* Kützing, it follows that *Papyracea* Stackhouse (1809) is synonymous with *Cryptopleura* Kützing (1843), which genus has been restored by Kylin (1924). *Cryptopleura* Kützing has been proposed for conservation by Silva (1950) against the earlier homonym of *Cryptopleura* Nuttall.

In regard to the type species of *Cryptopleura*, namely, *C. lacerata*, it should be noted that although this name has for a long time been associated with a European member of the Delesseriaceae, the name-bringing entity, *Fucus laceratus* Gmelin (1768, p. 179, pl. 21, fig. 4), was based upon specimens from the East Indies and England. Although Gmelin's illustration shows a plant that bears some slight resemblance to *Cryptopleura lacerata* it is not certain that it actually is representative of this species. This, to judge from a remark of Turner (1808, p. 154), is a conclusion at which Mertens also had arrived.

Among the early authors who have dealt with *Cryptopleura lacerata* there are two, Hudson (1778, p. 580, under *Fucus crispatus*) and Withering (1796, p. 103, under *Fucus cristatus*), who have cited the binomial *Ulva ramosa* Hudson (1762, p. 476) as a synonym of this species.

In 1902, when *Cryptopleura* was regarded as synonymous with *Nitophyllum*, Batters (p. 75) substituted the binomial *Nitophyllum ramosum* (Huds.) Batters for *N. laceratum* (Gmel.) Greville, and in 1931 the combination *Cryptopleura ramosa* was made by Kylin (*in* Newton, 1931, p. 332).

Pinnatifida Stackhouse, 1816, pp. ix, xii.

This genus was based on five species, all of which are synonymous with *Fucus pinnatifidus* Hudson (1762, p. 473) or *Laurencia pinnatifida* (Huds.) Lamouroux (1813) at it is now known.

Pinnatifida replaced Stackhouse's genus *Osmundea* of 1809, which was based on *Fucus Osmunda* Gmelin (1768) or *Laurencia pinnatifida* (Huds.) Lamour. var. *Osmunda* (Gmel.) Kützing, as it is now known. *Laurencia* Lamouroux (1813) has been proposed for conservation by Papenfuss (1947).

Plocamia Stackhouse, 1816, pp. x, xii.

Plocamia was a substitution for Stackhouse's genus *Nereidea* of 1809. His *Nereidea* of 1816 is synonymous with *Gelidium* Lamouroux (1813).

Stackhouse placed two species in *Plocamia*. Both are representative of *Plocamium* Lamouroux, viz., *P. coccineum* (Huds.) Lyngbye (= *Fucus plocamium* Gmelin, 1768). *Plocamium* Lamouroux (1813) has been conserved against *Nereidea* Stackhouse (1809).

Plumaria Stackhouse, 1809, pp. 58, 86-87.

This genus received one species, *Plumaria pectinata* (Gunner.)

Stackh. (= *Fucus pectinatus* Gunnerus, 1772, p. 122). The generic name is derived from *Fucus plumosus* Hudson (1762, p. 473), which is synonymous with *Fucus pectinatus*.

Plumaria Stackhouse is synonymous with *Ptilota* C. Agardh (1817), but Papenfuss (1947, p. 14) has proposed *Plumaria* Schmitz (1896) for conservation against *Plumaria* Stackhouse.

Polymorpha Stackhouse, 1809, pp. 55, 71-74; 1816, pp. viii, xi.

Eleven species were included in this genus when it was established by Stackhouse in 1809. Inasmuch as the name-bringing entity, and hence the type, *Fucus polymorphus* Lamouroux (1805, p. 1), and at least four of the other species are representative of *Chondrus* Stackhouse, viz., *Chondrus crispus* Stackh. *Polymorpha* Stackhouse (1809) must be regarded as synonymous with *Chondrus* Stackhouse (1797), which genus was ignored by its author in 1809.

In 1816 Stackhouse's concept of *Polymorpha* was much the same as in 1809, although some of the original species had been eliminated from the genus and others added.

Prolifera Stackhouse, 1809, pp. 56, 77-78.

Stackhouse attributed only two species to this genus, *Fucus rubens* Linnaeus (1753) and *P. angustifolia* Stackhouse (*nomen nudum*). *Fucus prolifer* Lightfoot (1777), which is synonymous with *F. rubens* L., furnished Stackhouse with the generic name.

Since *Fucus rubens* L. is also the type species of *Phyllophora* Greville (1830), it follows that *Prolifera* Stackhouse (1809) is wholly synonymous with *Phyllophora*. The latter name has been conserved against *Membranifolia* Stackhouse (1809), which is based on *Fucus membranifolius* Goodenough et Woodward (1797) or *Phyllophora membranifolia* (Good. et Woodw.) J. Agardh as it is now known.

Sarcophylla Stackhouse, 1816, pp. viii, xi.

This genus of Stackhouse received species, including the types, belonging to three of the genera which he had established in 1809, namely, *Dilsea*, *Ciliaria* and *Palmaria*. *Rhodymenia* Greville (1830) and *Calliblepharis* Kützing (1843) have been conserved against *Palmaria* and *Ciliaria*, respectively, and *Dilsea* is still accepted.

In view of the fact that Stackhouse (1816, p. viii) in his diagnosis of *Sarcophylla* referred to his figures of *S. ciliata* (pl. 15) as illustrative of the genus, it probably is justifiable to regard this species as the nomenclatural type of the genus; and on this basis *Sarcophylla* becomes a synonym of *Calliblepharis*.

Scorpiura Stackhouse, 1816, pp. ix, xii.

Two species were accredited to *Scorpiura* by Stackhouse, *Fucus amphibius* Hudson (1778) and *F. incrassatus* Turner (which apparently is a *nomen nudum*).

The generic name is derived from *Fucus scorpioides* Hudson (1762), which is synonymous with *F. amphibius*. *Scorpiura* Stackhouse (1816) is thus wholly synonymous with *Amphibia* Stackhouse (1809), which epithet has been rejected in favor of the conserved name *Bostrychia* Montagne (1838).

Sedoidea Stackhouse, 1809, pp. 57, 83.

Stackhouse placed two species in this genus. One of them, *Sedoidea olivacea*, is a species of doubtful status and the other one, *S. purpurea*, is synonymous with *Fucus sedoides* Goodenough et Woodward (1797, p. 117), which furnished the generic epithet and accordingly should be regarded as the type of *Sedoidea*.

Since *Fucus sedoides* Good. et Woodw. and *Sedoidea purpurea* Stackh. are synonyms of the type species of the genus *Gastroclonium* Kützing (1843), viz., *G. ovatum* (Huds.) Papenfuss (1944, p. 344; 1947, p. 14) it follows that *Sedoidea* is an illegitimizing synonym of *Gastroclonium*. The latter name was recently proposed for conservation against the former by Papenfuss (1947).

Sphaerococcus Stackhouse, 1797, pp. xvi, xxiv.

When he established this genus in 1797 Stackhouse assigned to it a total of 37 species. Stackhouse was aware of the fact (*op. cit.*, p. xvi) that *Sphaerococcus* contained a heterogeneous assemblage of species and in the course of time all but one of the original 37 species were removed from the genus.

Since the time that Greville (1830, p. 137) wrote: „Of *Fucus coronopifolius* of authors, I have perfect individuals in all states, and it is upon this species that I found my genus [*Sphaerococcus* Stackh.]”, *Sphaerococcus* has been typified with *S. coronopifolius* (Good. et Woodw.) Stackhouse. Even at present *S. coronopifolius* is the only species which with certainty can be assigned to this genus.

Sphaerococcus Stackhouse (1797) has been conserved against *Euspiros* Bertoloni (1819) and *Volubilaria* Lamouroux (1824), but this was unnecessary.

Tubicularia Stackhouse, 1816, pp. x, xii.

Two species were placed in this genus by Stackhouse. The one, *Tubicularia purpurascens*, was based on *Fucus purpurascens* Hudson (1778, p. 589) which, however, had been described previously by Hudson (1762, p. 471) as *Fucus purpureus* and is now known as *Cystoclonium purpureum* (Huds.) Batters (1902, p. 68). The second species, *Tubicularia pusilla*, was based on *Fucus pusillus* Stackhouse (1801, p. 16, pl. 6) and it is now known as *Gelidium pusillum* (Stackh.) Le Jolis (1863).

The name-bringing and hence the type species of *Tubicularia* is *Fucus tuberculatus* Lightfoot (1777, p. 926). Since the latter name is synonymous with *Fucus purpureus* Hudson (1762) or *Cystoclonium*

purpureum (Huds.) Batters, as the species is now known, it follows that *Tubercularia* Stackhouse (1816) is synonymous with *Cystoclonium* Kützing (1843, p. 404), which is likewise based on *Fucus purpureus* (or *F. purpurascens* as he called it). *Cystoclonium* Kützing is valid, however, because *Tubercularia* Stackhouse is a later homonym of *Tubercularia* Wiggers (1780).

Verrucaria Stackhouse, 1816, pp. ix, xi.

Stackhouse placed three species in this genus, viz., *Verrucaria verrucaria*, *V. elongata* and *V. confervoides*. All are synonymous with the species that has for a long time been known as *Gracilaria confervoides* (L.) Greville.

The generic name *Verrucaria* is derived from the specific epithet of *Fucus verrucosus* Hudson (1762, p. 470; 1778, p. 588), which is an older name for the plant which Linnaeus in 1763 (p. 1629) described as *Fucus confervoides* and which is now known as *Gracilaria confervoides*.

Since *Gracilaria* Greville (1830) has been typified by Schmitz (1889, p. 443) and others with *Fucus confervoides* L., it follows that *Verrucaria* Stackhouse (1816) is wholly synonymous with *Gracilaria*, which name has been conserved against *Ceramianthemum* Donati (1753). The combination *Gracilaria verrucosa* (Hudson) Papenfuss has been made in the present article.

Lichenes.

Pygmaea Stackhouse, 1809, pp. 60, 95; 1816, pp. x, xii.

This genus was erected by Stackhouse to receive the species *Pygmaea lichenoides*, which previously had been described as *Fucus pygmaeus* by Lightfoot (1777, p. 964, pl. 32), as *Fucus pumilus* by Hudson (1778, p. 584) and as *Fucus lichenoides* by Goodenough and Woodward (1797, p. 192).

Pygmaea Stackhouse (1809) is an older name for *Lichina* C. Agardh (1817, pp. xii, 9). O. Kuntze (1891, p. 876) has restored the former name and has made the combination *P. pumila* (Huds.) O. Kuntze.

Generic Name Proposed For Conservation.

In addition to *Gelidium* Lamouroux, *Gastroclonium* Kützing, *Plumaria* Schmitz, *Dasyphila* O. G. Sonder, *Chondria* C. Agardh and *Laurencia* Lamouroux, which have been proposed by Papenfuss (1947) for conservation against genera of Stackhouse, still one other genus, *Gloiosiphonia* Carmichael, is illegitimatized by a genus of Stackhouse. It is therefore proposed that this name be considered for conservation.

GLOIOSIPHONIA Carmichael (Gloiosiphoniaceae) *in* Berkeley, Cleanings Br. alg. 45. 1833.

versus

Capillaria Stackhouse, Tent. mar.-crypt. 58, 87-88. 1809.

Type species: *Gloiosiphonia capillaris* (Hudson) Carmichael.

Index of the genera of Stackhouse and their currently accepted equivalents.

Name of Stackhouse	Currently accepted name and author
	Chlorophycophyta
<i>Codium</i>	<i>Codium</i> Stackhouse
	Phaeophycophyta
<i>Abrotanifolia</i>	<i>Cystoseira</i> Agardh, nom. conserv.
<i>Ascophyllum</i>	<i>Ascophyllum</i> Stackhouse
<i>Bifurcaria</i>	<i>Bifurcaria</i> Stackhouse
<i>Carpolepta</i>	<i>Bifurcaria</i> Stackhouse
<i>Chorda</i>	<i>Chorda</i> Stackhouse
<i>Ericaria</i>	<i>Cystoseira</i> Agardh, nom. conserv.
<i>Filum</i>	<i>Chorda</i> Stackhouse
<i>Fistularia</i>	<i>Ascophyllum</i> Stackhouse
<i>Gigantea</i>	<i>Laminaria</i> Lamouroux, nom. conserv.
<i>Halidrys</i>	<i>Fucus</i> Linnaeus
<i>Herbacea</i>	<i>Desmarestia</i> Lamouroux, nom. conserv.
<i>Hippurina</i>	<i>Desmarestia</i> Lamouroux, nom. conserv.
<i>Hyalina</i>	<i>Desmarestia</i> Lamouroux, nom. conserv.
<i>Iridea</i>	<i>Desmarestia</i> Lamouroux, nom. conserv.
<i>Lorea</i>	<i>Himanthalia</i> Lyngbye, nom. conserv.
<i>Moniliifera</i>	<i>Cystoseira</i> Agardh, nom. conserv.
<i>Musaefolium</i>	<i>Alaria</i> Greville, nom. conserv.
<i>Orgyia</i>	<i>Alaria</i> Greville, nom. conserv.
<i>Phryganella</i>	<i>Cystoseira</i> Agardh, nom. conserv.
<i>Polypodoidea</i>	<i>Dictyopteris</i> Lamouroux, nom. conserv. prop.
<i>Polyschidea</i>	<i>Saccorhiza</i> DelaPylaie, nom. conserv.
<i>Saccharina</i>	<i>Laminaria</i> Lamouroux, nom. conserv.
<i>Siliquaria</i>	<i>Halidrys</i> Lyngbye, nom. conserv.
	Rhodophycophyta
<i>Amphibia</i>	<i>Bostrychia</i> Montagne, nom. conserv.
<i>Atomaria</i>	<i>Odonthalia</i> Lyngbye, nom. conserv.
<i>Bifida</i>	<i>Rhodophyllis</i> Kützing, nom. conserv.
<i>Capillaria</i>	<i>Gloiosiphonia</i> Carmichael, nom. conserv. prep.
<i>Chondrus</i>	<i>Chondrus</i> Stackhouse
<i>Ciliaria</i>	<i>Calliblepharis</i> Kützing, nom. conserv.
<i>Clavatula</i>	<i>Gelidium</i> Lamouroux, nom. conserv. prop.
<i>Cornea</i>	<i>Gelidium</i> Lamouroux, nom. conserv. prop.
<i>Coronopifolia</i>	<i>Gelidium</i> Lamouroux, nom. conserv. prop.
<i>Dasyphylla</i>	<i>Sphaerococcus</i> Stackhouse
<i>Dilsea</i>	<i>Chondria</i> Agardh, nom. conserv. prop.
<i>Epiphylla</i>	<i>Dilsea</i> Stackhouse
<i>Fastigiaria</i>	<i>Phyllophora</i> Greville, nom. conserv.
<i>Fimbriaria</i>	<i>Furcellaria</i> Lamouroux, nom. conserv.
<i>Flagellaria</i>	<i>Odonthalia</i> Lyngbye, nom. conserv.
<i>Fuscaria</i>	<i>Gracilaria</i> Greville, nom. conserv.
<i>Gigartina</i>	<i>Rhodomela</i> Agardh, nom. conserv.
<i>Hydrolapathum</i>	<i>Gigartina</i> Stackhouse
<i>Hydrophyllum</i>	<i>Delesseria</i> Lamouroux, nom. conserv.
	<i>Delesseria</i> Lamouroux, nom. conserv.

<i>Hymenophyllum</i>	<i>Cryptopleura</i> Kützing, nom. conserv. prop.
<i>Hypophyllum</i>	<i>Membranoptera</i> Stackhouse
<i>Kaliformia</i>	<i>Chylocladia</i> Greville, nom. conserv.
<i>Kaliformis</i>	<i>Chylocladia</i> Greville, nom. conserv.
<i>Mammillaria</i>	<i>Gigartina</i> Stackhouse
<i>Membranifolia</i>	<i>Phyllophora</i> Greville, nom. conserv.
<i>Membranoptera</i>	<i>Membranoptera</i> Stackhouse
<i>Nereidea</i>	<i>Plocamium</i> Lamouroux, nom. conserv.
<i>Osmundea</i>	<i>Laurencia</i> Lamouroux, nom. conserv. prop.
<i>Palmaria</i>	<i>Rhodymenia</i> Greville, nom. conserv.
<i>Papyracea</i>	<i>Cryptopleura</i> Kützing, nom. conserv. prop.
<i>Pinnatifida</i>	<i>Laurencia</i> Lamouroux, nom. conserv. prop.
<i>Plocamia</i>	<i>Plocamium</i> Lamouroux, nom. conserv.
<i>Plumaria</i>	<i>Ptilota</i> C. Agardh
<i>Polymorpha</i>	<i>Chondrus</i> Stackhouse
<i>Prolifera</i>	<i>Phyllophora</i> Greville, nom. conserv.
<i>Sarcophylla</i>	<i>Calliblepharis</i> Kützing, nom. conserv.
<i>Scorpiura</i>	<i>Bostrychia</i> Montagne, nom. conserv.
<i>Sedoidea</i>	<i>Gastroclonium</i> Kützing, nom. conserv. prop.
<i>Sphaerococcus</i>	<i>Sphaerococcus</i> Stackhouse
<i>Tubularia</i>	<i>Cystoclonium</i> Kützing
<i>Verrucaria</i>	<i>Gracilaria</i> Greville, nom. conserv.

Lichenes

Pygmaea

Pygmaea Stackhouse

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A peculiar method of sexual reproduction in certain new members of the Chlamydomonadaceae¹⁾

by

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(With three figures in the text).

The Chlamydomonadaceae dealt with in this paper appeared in cultures of desiccated soils collected from cultivated and uncultivated ground in North India. They were studied in unialgal cultures in which by repeated subculturing the bacterial numbers were kept low enough not to interfere with normal growth of the algae. The media used were De's (1939, p. 124) modification of Benecke's solution, with the addition of a little soil extract and sometimes of a morsel of cheese. Cultures were also grown on solid media prepared by adding 1.5 per cent agar to the solution.

The essential characteristics of the three species, whose sexual reproduction is described in the following, may first be given. They are:

1. *Chlamydomonas Iyengari* n. sp. (Fig. 1). Cells subspherical to slightly oblong, $6\text{-}12\mu$ long and $5\text{-}11\mu$ broad, with a thin wall, posterior end broadly rounded, anterior end narrowing to a truncate hyaline papilla. Flagella $10\text{-}15\mu$ long, arising from a small cytoplasmic beak below the middle of the anterior end, the base slightly thickened and harbouring the pyrenoid. Nucleus near the middle of the cell. Contractile vacuoles two, anterior. Stigma minute, punctiform, situated a little above the middle, but sometimes displaced towards the anterior end. Cell-division longitudinal. Gametes provided with membranes, $5\text{-}11\mu$ long and $5\text{-}10\mu$ broad, isogamous, fusing by the posterior ends. Zygospore spherical or oblong, diam. $10\text{-}16\mu$, pale orange, with a smooth hyaline wall, 1μ thick, liberating 1-8 individuals by an irregular rupture of the wall on germination.

¹⁾ Part of a thesis presented for the Ph. D. Degree of the University of London

Hab. In cultures of desiccated soils from cultivated wheat and rice fields and from a garden at Allahabad, N. India.

This species resembles *C. proboscigera* Korschikoff (Pascher, 1927, p. 216) except that the chloroplast shows no basal thickening, that the cells are smaller and exhibit gradual attenuation towards the anterior end, that the stigma is minute, and that the flagella are longer.

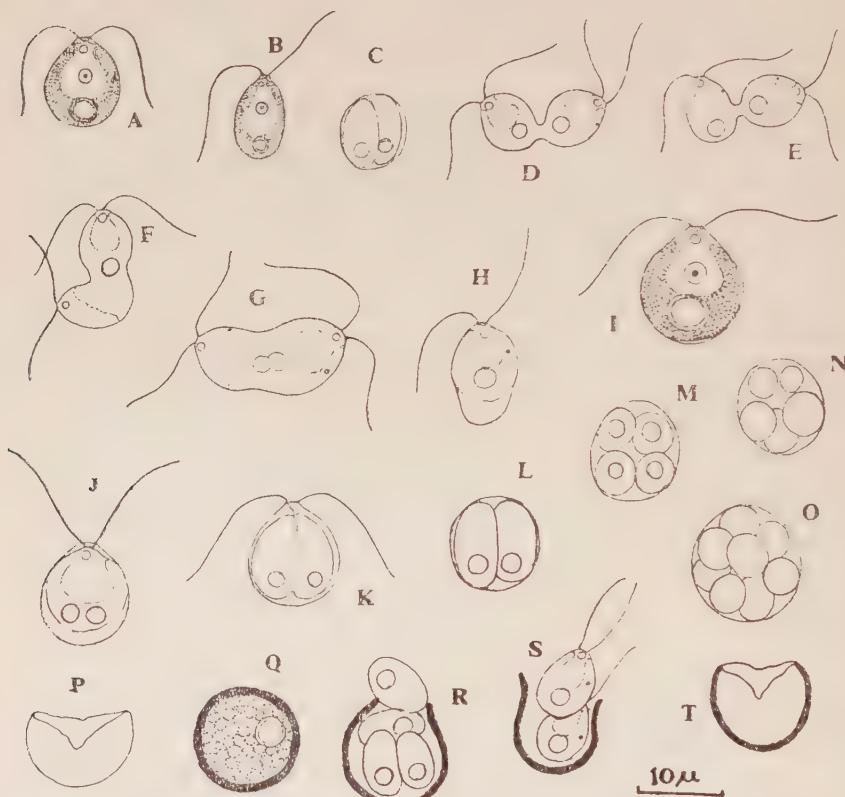


Fig. 1. *Chlamydomonas Iyengari* n. sp. — A, B, motile individuals; C, division; D, E, conjugation of gametes.. F-H. stages in conjugation; I, zygote; J.O, stages in division of zygote; P, empty wall of zygote; Q, zygospore; R, S, germination of zygospore; T, empty wall of zygospore.

2. *Chlamydomonas indica* n. sp. (Fig. 2). Cells ellipsoidal to oval, dorsiventral, $10-14\mu$ long and $6-10\mu$ broad, posterior end broadly rounded, anterior end narrowed to a truncate papilla. Flagella about as long as the body, emerging from the margins of the papilla. Chloroplast cup-shaped, thin, with a lateral pyrenoid, situated in a dorsal thickening of the chloroplast a little below the middle of

the cell. Nucleus anterior, displaced towards the ventral side. Eye-spot oval, towards the anterior end or sometimes near the middle. Contractile vacuoles two, anterior. Cell-division into two or four, the first division followed by rotation of the protoplast into the transverse plane. Gametes provided with membranes, isogamous, $7\text{-}10\mu$ long and $4\text{-}6\mu$ broad, conjugating by the posterior ends, zygotes oval, $14\text{-}17\mu$ long and $10\text{-}15\mu$ broad, biflagellate, the protoplast retracted from the wall at several points, after a long period of movement dividing into 4-8 daughter-cells.

Hab. In cultures of desiccated soils from rice fields and „usar” land near Allahabad, N. India.

This species resembles *C. gloeogama* Korschikoff (Pascher, 1927, p. 267), but the cells are at no time embedded in mucilage. The early stages of sexual reproduction in this species are very similar to those of *C. Iyengari*, but the two species differ markedly in the chloroplast and in the position of the pyrenoid.

3. *Carteria eugametos* n. sp. (Fig. 3). Cells almost cylindrical, often slightly curved and asymmetrical, $12\text{-}15\mu$ long, $7\text{-}10\mu$ broad, both ends rounded, cell-wall slightly thickened and somewhat mucilaginous, with a cruciately lobed and flattopped papilla, 1μ high and 2μ broad, the four flagella ($8\text{-}12\mu$ long) arranged crosswise and arising opposite its concave sides. Chloroplast deep green, cup-shaped, reaching the anterior end, the thickened base harbouring the pyrenoid which is laterally displaced and surrounded by large angular starch-grains. Nucleus in the hollow of the cup, displaced laterally. Stigma oval, in the anterior third of the cell. Contractile vacuoles two, anterior, indistinct. Cell-division usually into two, sometimes into four, the first division followed by rotation of the protoplast into the transverse plane. Vegetative cells behaving as isogametes and fusing by their posterior ends; the young zygote quadriflagellate, the empty membrane of one of the fusing gametes adhering posteriorly. Zygospores with orange-brown contents and a thick hyaline wall, the innermost layer 1μ thick and structureless, the middle layer $2\text{-}3\mu$ thick and stratified, the outermost layer derived from the membrane of the zygote, mucilaginous and often entirely diffluent; diameter of zygospore, excluding the outermost layer of the wall $22\text{-}27\mu$; zygospores on germination producing 8-16 individuals which are liberated in a vesicle.

Hab. In cultures (with cheese) of desiccated soils from rice fields near Allahabad, N. India.

This resembles *C. crucifera* Korschikoff (Pascher, 1927, p. 157) except in its smooth chloroplast and in the lateral displacement of the nucleus and pyrenoid. It also shows some resemblance to a form referred by Scherffel (1931, p. 233) to *C. Oliveri* West (misspelt

Olivieri) in which the papilla according to Pascher (1927, p. 152) may have the same structure as that of *C. crucifera* (erroneously referred to as *C. cruciata*). West (1915, p. 74, Fig. 1, A, B) states that in *C. Oliveri* there is „at the anterior end a perforated bluntly conical wart through which the four cilia pass” and „this is covered by a mucous cap which attains a thickness equal to the height of the perforated wart.” It is therefore doubtful whether Scherffel’s form is identical with *C. Oliveri* West. *C. eugametos* differs from it in possessing shorter flagella and a posterior pyrenoid.

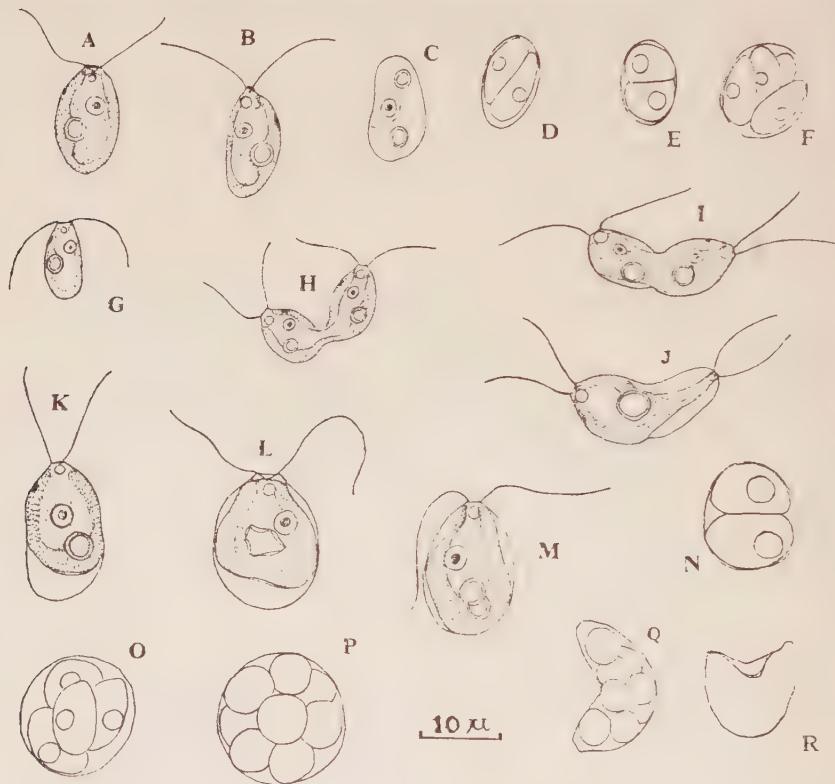


Fig. 2. *Chlamydomonas indica* n. sp. — A, B, motile individuals; C—F, stages in cell division; G, gamete; H, conjugation of gametes; I, J, stages in conjugation; K—M, zygotes; N—P, stages in division of zygote; Q, division of curved zygote; R, empty wall of zygote.

In the slightly dorsiventral species *Chlamydomonas indica* (Fig. 2, C, D, E) and *Carteria eugametos* rotation of the protoplast to the transverse plane takes place during the first division, but in the nearly spherical *Chlamydomonas Iyengari* there is no such rotation (Fig. 1, C). The two or four daughter-individuals are set free by gelatinisation of the wall in the two species of *Chlamydomonas*,

but in the larger *Carteria eugametos* they are liberated through a median pore or by rupture of the wall.

The sexual reproduction shows distinctive features. It has been repeatedly followed on individual pairs of fusing cells. The gametes in all three species are provided with membranes. In *Chlamydomonas indica* the gametes are formed by division and are smaller than the vegetative cells, but in *C. Iyengari* and *Carteria eugametos* they are of the same size as the latter and it is probable that the ordinary individuals behave as gametes. Conjugation is very frequent in these two species and, as in *C. indica*, takes place between similar gametes, although gametes of slightly different sizes may also fuse. None of the species show clump-formation.

In all of them the gametes, after moving around one another for some little time, come into contact by their posterior ends (Figs. 1, D; 2, H; 3,C), the two gametes being usually orientated approximately at right angles to one another. The only exception to this was occasionally observed in *Chlamydomonas Iyengari*, where one gamete sometimes became applied by its posterior end to the side of the other (Fig. 1, E). At the point of contact the wall separating the two gametes is dissolved and fusion of the protoplasts commences. At first the connecting bridge between the two is very narrow, but it widens considerably during fusion, although it never becomes as broad as the fusing cells themselves so that the latter are always separated by a slight constriction (Figs. 1, F, G; 2, I, J; 3,D-F). During the early stages of conjugation both gametes are comparatively quiescent, but after contact is firmly established the fusing pair moves vigorously with the help of the flagella of the respective gametes.

The fusing cells differ in their behaviour, since the contents of one gamete pass over entirely into those of the other (cf. Fig. 3, E). If one of the gametes is smaller, it acts as the male and its contents pass into those of the larger gamete. Soon after the commencement of fusion the cytoplasm of the active gamete begins to contract away from the wall on one side, while there is little or no such contraction in the other gamete (Figs. 2, I, J; 3, D, E). Subsequently contraction of the contents of the active gamete takes place also from other parts of its wall, although contact is maintained longest in the region where the flagella are attached. The hyaline strand of cytoplasm containing the contractile vacuoles becomes more and more stretched and ultimately breaks across and, when this happens, the flagella of the active gamete are shed. Thereafter the movement of the usually curved zygote is accomplished with the help of the flagella of the recipient gamete only. The flow of contents from the one to the other gamete now takes place more rapidly and is accompanied by a contraction of the empty gelatinous wall of the active gamete. The papilla on this empty wall remains recognisable for a time, but ultimately becomes indistinguishable.

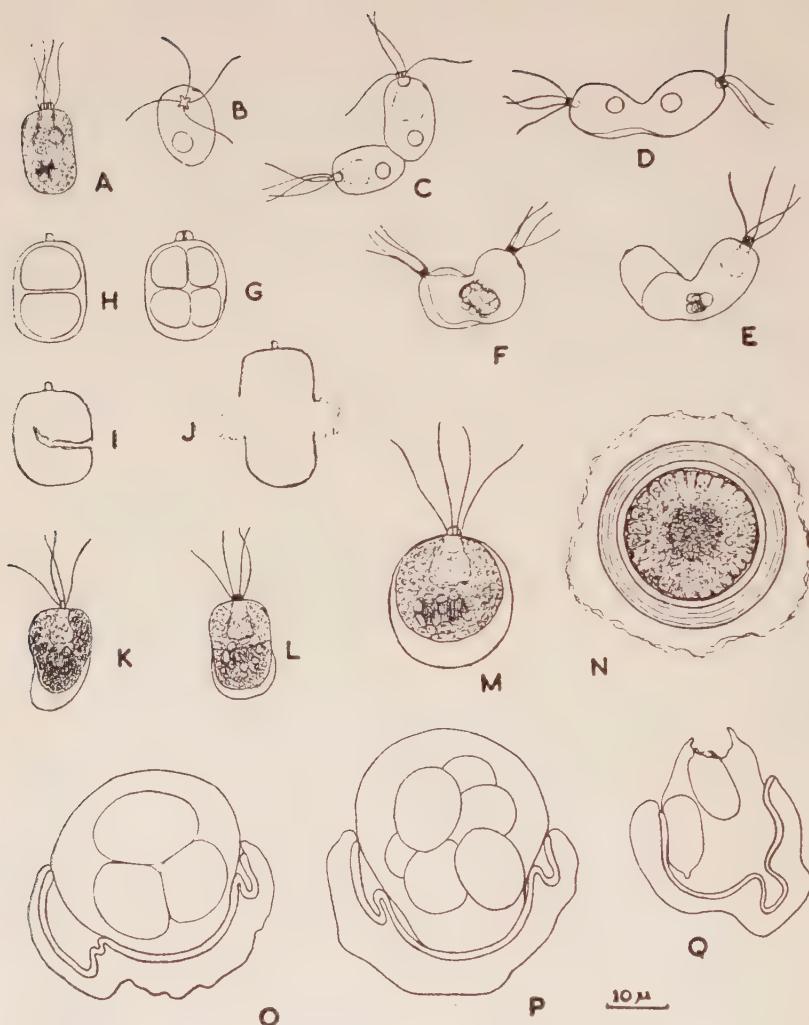


Fig. 3. *Carteria eugametos* n. sp. — A, motile individual B, cell seen from anterior end with cruciform papilla; C, conjugation of gametes, D—F, stages in conjugation; G—H, division of zygote; I, J, empty walls of zygotes; K—M, zygotes; N, zygospore; O—Q, germination of zygospores.

During fusion the pyrenoids become closely approximated (Fig. 1, G), and later only one is recognisable. The chloroplast of the active gamete loses its identity and merges with that of the other, imparting a deeper green colour to the zygote. The shrunken wall

of the active gamete forms a somewhat loose envelope around the posterior portion of the zygote (Figs. 2, K, L; 3, K) and in *Carteria eugametos* can often be distinguished as a faint line running across the middle of the latter (Fig. 3, L). In the two species of *Chlamydomonas*, which are smaller and have a thinner wall, such a line of demarcation is not visible.

The zygotes possess a deeper green colour and are slightly larger than the vegetative cells, while their protoplast is often retracted from the wall at various places (Fig. 2, M). There is a single eyespot. They move with the help of the persisting flagella of the vegetative cells. They continue to move for a period extending to several days, gradually assuming a subspherical or oblong shape (Figs. 1, I; 2, K, L; 3, L). Meanwhile there is appreciable enlargement, to about one and a half times the size of the vegetative cells in the species of *Chlamydomonas* and to more than twice the size of the newly formed zygote in *Carteria eugametos*. During this enlargement all traces of the wall of the active gamete are lost.

In cultures the zygotes usually divide without any resting period. The division takes place just as in the vegetative cells, being accompanied by a rotation of the protoplast in *Carteria eugametos* and *Chlamydomonas indica* (Fig. 2, N). The resulting four to eight daughter-individuals are slightly larger than those produced by vegetative cells. Only some of the four products of the first two divisions frequently divide so that five to eight daughter-individuals of varying sizes may be formed (Figs. 1, N; O; 2, P, Q). The daughter cells are usually liberated by rupture of the wall of the zygote and, in *Chlamydomonas indica* and *Carteria eugametos*, the separated halves remain visible for a long time.

In older cultures, on the other hand, the movements of the zygotes first become sluggish and finally the flagella are lost, while a thick hyaline wall is secreted around the contents which assume an orange colour. In *Chlamydomonas indica*, however, no such resting zygosores were formed. In *C. Iyengari* the wall of the zygospore is 1μ thick and single-layered (Fig. 1, Q), but in *Carteria eugametos* it is differentiated into an inner structureless layer, 1μ thick, and an outer stratified layer, $2-3\mu$ thick (Fig. 3, N). The original membrane of the zygote swells and often persists as a transparent mucilaginous covering of varying thickness around the zygospore (Fig. 3, N). In my cultures the zygosores were found to germinate at any stage of maturity. In *Chlamydomonas Iyengari* the contents divided into two, or more usually into four, parts which were liberated by an irregular rupture of the wall (Fig. 1, R, S). In rare instances the entire contents were set free as a single cell whose further fate was not observed. In *Carteria eugametos* (Fig. 3, O, P) the wall breaks open on one side and the contents emerge enclosed in a vesicle which has a rather firm envelope. This ruptures irregularly to set

free the daughter-individuals and becomes wrinkled soon after their discharge (Fig. 3, Q). In this species the zygospores give rise to eight to sixteen daughter-individuals which are reddish in colour at the time of liberation, but soon become green. After some time they may begin to conjugate in the characteristic manner.

Summary.

In the course of a study of Algae from Indian soils two new species of *Chlamydomonas* (*C. Iyengari*, *C. indica*) and a new species of *Carteria* (*C. eugametos*) were observed which are distinctive in the fact that their gametes conjugate by their posterior ends. Diagnoses of the new species are given. The gametes are provided with membranes. One of the fusing gametes receives the contents of the other, and the membrane of the active gamete, which has fused with that of the recipient gamete, forms a loose envelope around the zygote. The zygotes retain only the flagella of the recipient gamete. They are larger than the vegetative cells and may remain motile for some days. They frequently divide without a resting period, although zygospores were formed in old cultures of two of the species. Germination of these zygospores was observed.

The author is indebted to Prof. F. E. Fritsch, F. R. S. for advice and guidance in the course of this investigation.

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An investigation of the distribution in time and space of the algae of a British water reservoir¹⁾

BY

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I. INTRODUCTION.

The practice of storing river water in a reservoir in order to improve its quality has the disadvantage that during storage the amount of phytoplankton tends to increase. In view of the lack of

¹⁾ The substance of this paper formed part of a thesis accepted for the degree of Ph. D. in the University of London.

deailed information on the algal growth appearing in reservoirs, an investigation was undertaken of one of the Metropolitan Water Board reservoirs situated at Barn Elms, Hammersmith. This investigation had three objects: —

- i. to determine the relation between planktonic algae and those occupying the bottom and margin,
- ii. to determine, so far as possible, the manner of persistence of the species present,
- iii. to attempt a correlation of the algal periodicity with the physical and chemical properties of the water.

The reservoir selected has an area of 7.3 hectares and is 5.5m. deep. It is surrounded by grass banks and is not shaded. It is set in a clay puddle and has steeply sloping brick sides, interrupted by two wide ledges, the lower one being submerged (Fig. 1). Originally the bottom of the reservoir was gravel, but this is now covered with a thick deposit of odourless silt which, although grey on the surface, is black underneath: when exposed to air, this black silt quickly oxidises to a grey colour. Microscopic examination reveals little organic detritus, but the % loss on ignition is 36.4%, the total nitrogen content being 0.3% and 0.4% of the dry weight in February and June respectively. Tests for nitrate nitrogen were negative.

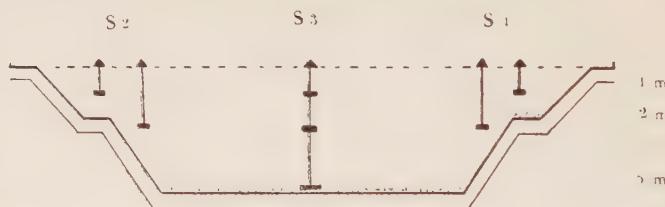


Fig. 1 Vertical Plan of the Reservoir, showing the position of the glass slides.

The water supplying the reservoir is drawn from the Thames at the Laleham intake, 14 miles from Hammersmith. It is first stored in Queen Mary Reservoir from which it passes along aqueducts and iron pipes to Barn Elms. Until March 1937 the reservoir was in constant use and there was a slight current across it, but after that date, owing to a heavy growth of *Carteria globosa*, the water was taken out of supply and the inlet closed, so that the reservoir became practically stagnant.

The reservoir is considerably deeper than most ponds, while unlike a silted lake it has no shallow marginal zone. The contour of the basin resembles that of a rocky lake. The macrophytic growth consists solely of *Zannichellia palustris*, which grows on the lower ledge from May to August or September. At a depth of 0.6-1 m. there is usually an extensive marginal growth of *Cladophora glomerata*,

bearing epiphytic diatoms, principally *Diatoma vulgare* var. *producta*, and *Cocconeis pediculus*.

Roach are abundant, while bream, perch and pike are plentiful. Swan, mallard, heron and migrant aquatic birds frequent the reservoir in large numbers. Rotifers were common in the zooplankton in both years, while Crustacea were plentiful only in 1937. The most important of the former were *Keratella cochlearis* (October and November 1936, May 1937, August 1938), *K. quadrata* (October and November 1936), *Polyarthra trigula* (March 1937), *Asplanchea priodonta* (August and November 1937), while *Bosmina longirostris* (September and October 1937), *Daphnia longispina* (June and September 1937) and *Cyclops (americanus?)* (June 1937) were the most abundant Crustacea.

II. CHEMICAL AND METEOROLOGICAL DATA.

Most of the chemical analyses were made weekly on unfiltered, surface water by the Metropolitan Water Board, but carbonates, bicarbonates, and pH were estimated fortnightly by me at the reservoir. The results are expressed as p.p. 100,000 and as averages for each month. Nitrogen and chlorides were determined by the methods given in the Report to the Royal Commission etc. (1904), phosphate and silica by the methods given in the Metropolitan Water Board's Annual Reports (1935, 1936), carbonate, bicarbonate and hardness by methods described by the American Public Health Association (1936). The chemical content of the water, like the phytoplankton, showed a seasonal periodicity, but were striking differences between the two years, which can be correlated with the fact that after March 1937 the reservoir became stagnant, the water not being renewed. Ammoniacal nitrogen, phosphate and silica increased, while nitrate nitrogen, carbonate and total hardness decreased. The increase in phosphate and silica may have been due to solution of these substances from the bottom silt.

The principal variations in the chemical composition of the water, and in the meteorological factors (Figs. 2 and 3) can be summarised as follows:

1. *Oxygen absorbed from permanganate* (in 3 hours at 80° F) and *albuminoid nitrogen* exhibit a correlation, the former varying between 0.153 and 1.38, and the latter between 0.016 and 0.274. The graph for the latter shows two peaks, one in March and the other in August-September. Rice (1938, p. 543) records maxima for albuminoid nitrogen in the Thames in June and in November or December.
2. *Ammoniacal nitrogen* fluctuates between 0.001 and 0.094, and apart from a slight time lag, the variations follow the same course.
3. *Oxidised nitrogen* varies between 0 and 0.27. One of the most striking results of closing the reservoir inlet was the immediate reduction of nitrate nitrogen, to which no doubt the previous maxi-

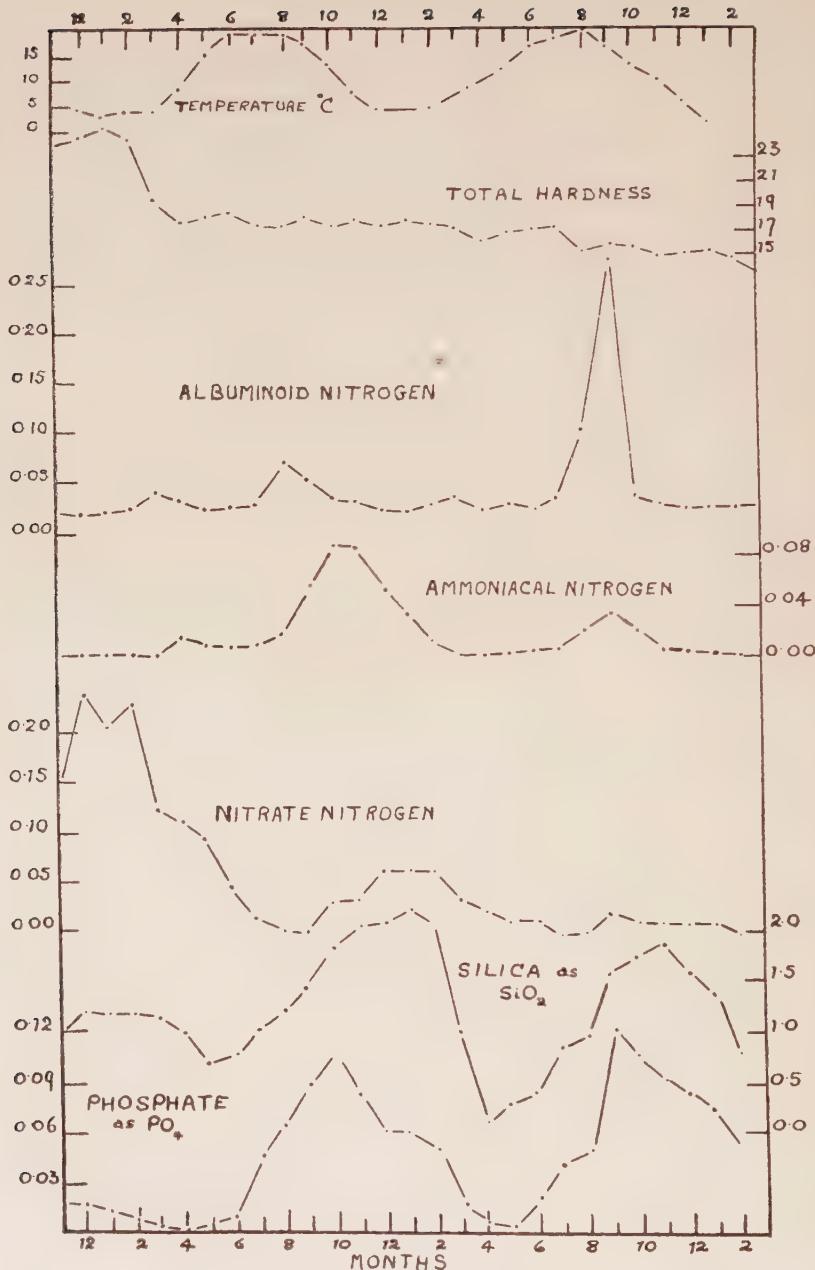


Fig. 2 Seasonal Variations in Dissolved Substances, expressed as monthly averages, in parts per 100,000.

mum attained by *Carteria globosa* contributed. The maxima in the ensuing winter were far less marked (Fig. 2), while during summer, the periods when nitrate was absent were more prolonged, the mean nitrate content steadily decreasing. The relative proportions of nitrate and ammoniacal nitrogen also changed; during autumn the concentration of the latter exceeded that of nitrate N, while during spring the converse was true.

4. *Silica* (as SiO_2) varies between 0.15 and 2.2, with a minimum in spring and a maximum in winter, which became more pronounced after the reservoir was isolated.

5. *Phosphate* (as PO_4) fluctuates between 0.001 and 0.123 ($P=0.003\text{--}0.041$), with a minimum in spring and a maximum in autumn.

6. *Bicarbonates* (as HCO_3) vary between 8.1 and 20.2, being lowest in August and highest in December.

7. *Carbonates* (as CO_3) fluctuate between 0 and 3.6, and vary inversely as the bicarbonates. Carbonates were precipitated during the spring maxima of *Carteria globosa*, *Stephanodiscus astraea* and *Asterionella formosa*.

8. *Hydrogen-ion concentration* (determined with a Lovibond comparator, using coloured glass standards) ranges between 8.0 and 9.0, with the highest values in summer.

9. *Total hardness* varies between 13.0 and 23.2, showing a sudden decrease after the reservoir was isolated, followed by a gradual fall.

10. *Permanent hardness* fluctuates between 4.9 and 7.7, with minima in spring and autumn and a maximum in winter.

11. *Temperature* of the water is based on daily maximum-minimum records at the reservoir. There was a slightly longer period of high temperatures in 1938 than in 1937.

12. *Rainfall*, records of which were kept at the reservoir, did not appear to have any effect.

13. *Sunshine* (records from Kew) was greater in the winter of 1936-1937 than in that of 1937-1938, but was greater in spring in 1938 than in 1937.

14. *The oxygen content* was determined only in July 1937. The % saturation of oxygen at 0m. with a temperature of 21°C was 106%, and at 3.5m. where the temperature was 19°C was 66%. There was no oxygen deficiency, nor was there any evidence of a thermocline.

15. *Chlorides*, estimated as chlorine, varied from 1.8 to 2.6 with maxima usually in December and January and again in July or August.

III. MODE OF COLLECTION OF THE SAMPLES.

Planktonic and non-planktonic algae were collected in alternate weeks, from October 1936 until January 1939. Surface samples for

phytoplankton were taken (1) from the centre, (2) from three stations situated respectively near the east and west sides, and at the south-west corner, and (3) from the water entering the Barn Elms series of reservoirs. The plankton in these samples was concentrated with the help of a hand centrifuge. A tow net sample was collected once a fortnight. From November 1937 onwards, samples were collected from 1,3 and 5m. depths at the centre, with the help of a Friedinger sampler.

For the study of non-planktonic growth, glass slides were fitted in metallic photographic frames (Butcher 1932), which were fastened in a horizontal position to moored wooden blocks. The slides, immersed at 1 and 2.4m. below the surface on the east and west margins,

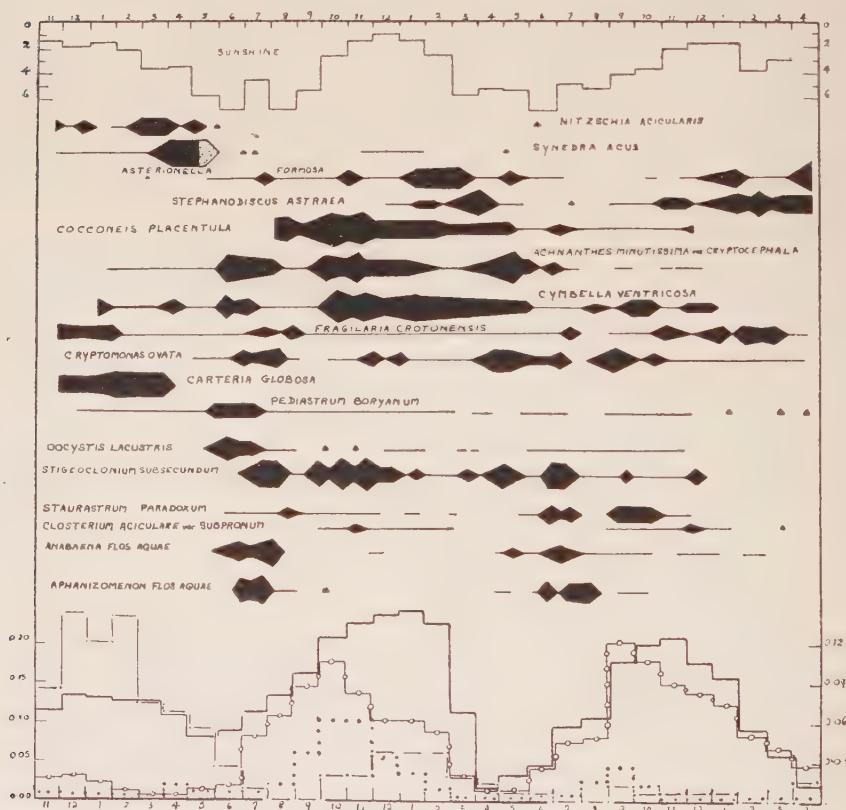


Fig.3 Correlation between the periodicity of certain algae and seasonal variations in the concentration of nitrate N ——, ammoniacal N (scale on the left), phosphate o—o—o—o—o—o (scale on the right), silica as —— (scale on the left X 10), and sunshine expressed as the average no. hours / day / month.

and at 1, 2.4 and 5.2m. in the centre (Fig. 1, SI-3) were exposed for periods varying between 2 and 8 weeks.

Algal growth was also scraped from the sides of the reservoir each fortnight. Samples of the bottom silt from the centre and the lower shelf were collected monthly, the former being examined after exposure to artificial illumination for 24 hours. Both lots of silt were covered with sterilised reservoir water, with distilled water or with nutrient solution, either that of Benecke (Geitler, 1932, p. 114) or Uspenskaja (1930). The cultures were exposed to daylight and continuously illuminated by a 60 watt lamp, and examined monthly for three months. In May 1938 a sample of bottom silt (72cc.) was covered with 24 litres of sterilised reservoir water, artificially aerated and enriched by the addition of 0.3072gms. of potassium nitrate; it was exposed to daylight.

IV. THE PHYTOPLANKTON.

i. *Composition.* The species that play a conspicuous part in the phytoplankton are grouped in Table 1. The plankton is eutrophic and is made up of many species, few of which are common at any one time. It includes a considerable number which are typical of the pelagic plankton of lakes with an appreciable admixture of those more usually met with in ponds. The total absence of *Tabellaria*, the rarity of *Melosira* and Dinoflagellates, and the small number of diatoms are noteworthy.

Carteria globosa, *Stephanodiscus astraea*, *Synedra acus*, *Anabaena flos aquae* and *Aphanizomenon flos aquae* dominated the plankton at one or other time, the last two being abundant in early summer of both years. *Carteria globosa* was only present in 1937, while *Synedra acus* was very rare in 1938 when *Stephanodiscus astraea* first became abundant. The species grouped as sometimes common showed similar striking differences in behaviour in the two years. Thus, most of the Chlorophyceae, which were common in 1937, were rare or absent in 1938 when the plankton was dominated by diatoms and Myxophyceae. *Closterium aciculare* var. *subpronum* and *Staurastrum paradoxum* were however, common in both years, while *Planktosphaeria gelatinosa* was common only in 1938. Of the diatoms, *Nitzschia acicularis* was very rare in 1938, while *Melosira granulata* var. *angustissima* and *Asterionella formosa*, though present in 1937, attained a maximum growth only in the following year and *Fragilaria capucina* was present only in 1938. *Anabaena spiroides* and *Microcystis aeruginosa* were common only in 1937 and 1938 respectively.

A considerable number of the species which were rare in the plankton, though frequent on the slides and among the marginal growth, are attached forms, epiphytes or silt-inhabiting diatoms, all of which are unsuited to a free-floating existence.

Of the species present in the inflowing water at the inlet before *Carteria globosa**, *Pediastrum Boryanum*, *Coelastrum microporum**,

it was closed, asterisk superscript *Stigeoclonium subsecundum**, *Diatoma vulgare* var. *producta**, *Asterionella formosa*, *Synedra acus*, *Cymbella ventricosa*, and *Nitzschia acicularis* were rare and *Fragilaria cratonensis* only once frequent, although all these species became common in the reservoir. The species marked with an asterisk are not recorded by Rice (1938) from the Thames so that they may have been introduced from Queen Mary Reservoir.

The phytoplankton of the reservoir and that of the Thames from which its water was derived are indeed very different. In the latter Myxophyceae are unimportant and non-planktonic diatoms play an important rôle (Rice 1938). At Shepperton, the point nearest to the Laleham intake, the river plankton is largely dominated by Green Algae in summer and by non-planktonic diatoms at other times of the year, while *Synura* and *Dinobryon* are sometimes common in spring and summer respectively. Only *Pediastrum Boryanum*, *Fragilaria crotonensis*, *F. capucina*, and *Nitzschia acicularis* are common alike in the plankton of the river and the reservoir. Several diatoms (e.g. *Melosira varians*, *Amphora ovalis*, *Nitzschia linearis*), which are frequent in the river plankton, are common in the marginal growth of the reservoir.

Species like *Scenedesmus obliquus*, *Closterium aciculare* var. *subpronum*, *Staurastrum paradoxum*, *Stephanodiscus astraea*, which are poorly represented in the Thames plankton, prosper in the reservoir, where they constitute important members of the phytoplankton, while others, which are important in the river, disappear before the water reaches the reservoir. The species of *Oocystis* and *Anabaena*, as well as *Aphanizomenon flos aquae*, which are common in the reservoir, are not recorded from the river. The majority of the constituents of the phytoplankton of the reservoir have thus probably been introduced either from the Thames or from Queen Mary Reservoir, while some have been brought direct to the Barn Elms reservoir by wind or birds.

ii. *Degree of Constancy.* Except for *Cryptomonas ovata*, all the species were absent from one or more samples. *Pediastrum Boryanum*, *Fragilaria crotonensis*, *Asterionella formosa* and *Cryptomonas ovata*, present in more than 75% of the samples can be described as constant, whilst *Oocystis Naegelii*, *Coelastrum microporum* and *Staurastrum paradoxum*, present in 66-75% of the samples are subconstant. The remaining 23 species were present in less than 66% of the samples. The degree of constancy of a species is variable (Pearsall, 1923, 1925; Ruttner, 1930; Rice, 1938), and several species which were subconstant or occasional in the reservoir (e.g. *Staurastrum paradoxum*, *Stephanodiscus astraea*) are recorded as perennial elsewhere, although it is not clear whether this amounts to occurrence in 100% of the samples. A low degree of constancy does not imply that the species plays an insignificant rôle, since occasional species like *Quadrigula closterioides*, *Fragilaria capucina*, *Anabaena*

spiroides and *Microcystis aeruginosa* at certain times, played a very important part in the economy of the reservoir.

iii. *Horizontal and Vertical Distribution.* (cf. Table 1). The horizontal distribution of planktonic species may give some indication as to the location of persisting individuals or of resting stages between two periods of occurrence. A considerable number of the species were equally distributed in centre and marginal samples at the time of their maximum frequency, as well as at their first or last appearance in the plankton. Some however, showed a tendency to be most abundant in the marginal samples. This was true of *Melosira granulata* var. *angustissima*, *Fragilaria crotonensis*, *Asterionella formosa* and *Anabaena flos aquae*, both in 1937 and 1938, while *Oocystis eremosphaeria*, *Coelastrum microporum*, *Closterium peracerosum* and *Anabaena spiroides* exhibited such marginal abundance in 1937 only, and *Planktosphaeria gelatinosa*, *Closterium aciculare* var. *subpronum*, *Microcystis aeruginosa* and *Aphanizomenon flos aquae* in 1938 only. None of these (except *Melosira granulata* var. *angustissima* in July 1938, and *Anabaena spiroides* in September 1937) ever showed a greater abundance in the centre samples at the time of their maximum. There is thus some indication that *Anabaena flos aquae* and the three diatoms first mentioned above may take their origin from the marginal region, and this may perhaps be suspected for all the species just enumerated. Only the species of *Pediastrum*, *Oocystis Naegelii*, *O. lacustris*, *Quadrigula closterioides* and *Anabaena spiroides*, all of which developed a maximum only in 1937, were then most abundant in the centre samples.

The majority of the plankton species were either equally distributed in the horizontal samples or confined to the marginal ones at the time of their first and last appearance. Some species however, were even at times of scarcity represented by occasional persisting individuals. This was true of *Pediastrum Boryanum*, *Oocystis Naegelii*, *Closterium aciculare* var. *subpronum* (1938), *Staurastrum paradoxum*, *Melosira granulata* var. *angustissima*, *Stephanodiscus astraea*, *Fragilaria crotonensis*, *Asterionella formosa*, *Cryptomonas ovata*, *Cryptomonas* sp., *Trachelomonas volvocina*.

As regards their vertical distribution at the time of the maximum, some species are more abundant in the upper 3 m. For instance, *Planktosphaeria gelatinosa*, *Closterium aciculare* var. *subpronum*, *Melosira granulata* var. *angustissima*, *Cryptomonas* sp., *Anabaena flos aquae*, *Aphanizomenon flos aquae* were at the time of maximum mainly distributed between the surface and 1 m. while *Cryptomonas ovata*, *Trachelomonas volvocina* and *Fragilaria crotonensis* were common between the surface and 3 m. although on one occasion *F. crotonensis* produced a maximum at 5m. Other species (*Staurastrum paradoxum*, *Stephanodiscus astraea*, *Fragilaria capucina*, *Asterionella formosa*) at first develop a maximum in the upper layers and later become common in the lower layers.

After the terminaton of the maximum, some species (*Pediastrum duplex* var. *clathratum*, *Scenedesmus obliquus*, *Fragilaria capucina*, *Synedra acus*) were uniformly distributed in the depth samples, while others (*Planktosphaeria gelatinosa*, *Oocystis lacustris*, *O. Naegelii*, *Closterium peracerosum*, *Aphanizomenon flos aquae*, *Anabaena spiroides*) were last seen in surface samples.

iv. Occurrence of the Planktonic Species in the Other Habitats.
Only *Phacotus lenticularis*, *Pediastrum Boryanum*, *Scenedesmus obliquus*, *S. quadricauda* var. *longispina*, *Stephanodiscus astraea*, *Fragilaria crotonensis* and *Asterionella formosa* occurred more frequently on the slides and among the marginal growth than in the plankton. Others (*Carteria globosa*, *Oocystis lacustris*, *O. Naegelii*, *Nitzschia acicularis*, *Anabaena spiroides*) were equally common on the slides or (*Microcystis aeruginosa*, *Anabaena flos aquae*) in the marginal growth. *Carteria globosa*, *Oocystis lacustris*, *O. Naegelii*, the species of *Scenedesmus* and *Fragilaria capucina* were found commonly on the slides before they became plentiful in the plankton; all of these except *Oocystis Naegelii* were first common on the marginal slides. *F. capucina*, as well as *Microcystis aeruginosa*, were frequent on the lower shelf and among the attached growth a fortnight or more before they became common in the plankton, while *Anabaena spiroides* appeared first on the shelf and among the attached growth.

As might be expected several species (e.g. *Coelastrum microporum*, *Staurastrum paradoxum*, *Closterium aciculare* var. *subpronum*, *Stephanodiscus astraea*, *Asterionella formosa*) were found commonly on the slides after their planktonic maximum, being usually most frequent on the 1m. slides, although some (*Coelastrum microporum*, *Fragilaria capucina*, *Synedra acus*, *Nitzschia acicularis*) were equally distributed at all depths or (*Phacotus lenticularis*, *Asterionella formosa* in 1938) commoner on the 2.4m. slides. *Pediastrum Boryanum*, *Synedra acus* and *Stephanodiscus astraea* became common on the 5.2m slides after the maximum, the last being found also in some numbers on the bottom silt. This same species, as well as *Asterionella formosa*, *Anabaena flos aquae* and *Aphanizomenon flos aquae* were common on the lower shelf after the planktonic maximum. Species persisting among the attached growth were *Pediastrum duplex* var. *clathratum*, *P. Boryanum*, *Oocystis lacustris*, *O. eremosphaeria*, *Scenedesmus obliquus*, *S. quadricauda* var. *longispina*, *Coelastrum microporum*, *Closterium aciculare* var. *subpronum*, *Staurastrum paradoxum*, *Fragilaria capucina* (also on the lower shelf), *Synedra acus*, and *Nitzschia acicularis*. *Anabaena spiroides* occurred in the silt when absent from other parts of the reservoir.

Planktonic species often occurred in the cultures of silt from the lower shelf and from the bottom of the reservoir (p. 17) Some of them (*Pediastrum Boryanum*, *Fragilaria capucina*, *Microcystis aeruginosa*, *Aphanizomenon flos aquae*) were present in the plankton

at the time when the cultures were set up, but this was not true of others (*Pediastrum duplex* var. *clathratum*, *Coelastrum microporum*, *Closterium peracerosum*). These facts suggest that the silt harboured persisting individuals.

In cultures of bottom silt in distilled or reservoir water, *Scenedesmus quadricauda* var. *longispina*, *Nitzschia acicularis*, *Tribonema monochloron*, *Anabaena flos aquae*, *A. spiroides* and *A. torulosa* var. *tenuis* became common, the last species being found only in the cultures. With a nutrient solution additional forms, such as *Chromulina*, sp. and *Melosira granulata* var. *angustissima* were frequent, while occasional individuals of *Gonium* sp. and *Pandorina morum* appeared. In the culture to which nitrate was added [p. 17] *Chlamydomonas* sp., *Fragilaria capucina* and *Nitzschia acicularis* were common, with rare individuals of *Tetraëdron muticum*, *Gonium* sp., *Scenedesmus* spp., *Coelastrum microporum*, *Synedra acus*, *Anabaena spiroides*, *A. torulosa* var. *tenuis* and *A. flos aquae*. The last was the only one of these species present in the plankton when the culture was started.

The data afforded by the horizontal distribution and by the appearance of plankton species in cultures of the silt provide considerable evidence that species of *Scenedesmus*, *Coelastrum microporum*, *Fragilaria capucina*, *Nitzschia acicularis*, *Anabaena flos aquae* and *A. spiroides* persist in the silt. A similar conclusion is suggested for *Carteria globosa*, the species of *Pediastrum*, *Oocystis* and *Closterium*, *Planktosphaeria gelatinosa*, *Staurastrum paradoxum*, *Melosira granulata* var. *angustissima*, *Fragilaria crotensis*, *Synedra acus*, *Microcystis aeruginosa* and *Aphanizomenon flos aquae*, although the evidence is not so satisfactory. There is no evidence as to the place of persistence of *Quadrigula closterioides*, *Coronastrum anglicum*, *Stephanodiscus astraea*, *Asterionella formosa*, *Cryptomonas ovata* and *Trachelomonas volvocina* when absent from the plankton. Spore formation was observed only in *Carteria globosa*, *Staurastrum paradoxum*, *Anabaena flos aquae*, *A. spiroides* and *Aphanizomenon flos aquae*.

V. NON-PLANKTONIC GROWTH.

This comprises (1) species attached to the brick sides of the reservoir or the glass slides, (2) epiphytes, (3) silt-inhabiting forms.

i. *Cladophora glomerata*, *Synedra ulna* var. *amphirhynchus* and *Cymbella cistula* were abundant on the sides of the reservoir, the last also occurring plentifully on the slides. Other species of this category, however, such as *Tetraspora* sp., *Stigeoclonium subsecundum*, *Ulothrix* sp., *Calothrix* sp. and *Phormidium tenue* attained their highest frequency on the glass slides which seem to be selective, since *Cladophora glomerata* was only once common there. *Ulothrix* sp. and *Cladophora glomerata* were more frequent on the marginal slides, while the others developed maxima on the centre slides. Their

extensive growth here may be due to less acute competition between individuals and species than on the marginal slides.

Most of the attached species were best represented on the 1m. slides, but *Ulothrix* sp., *Phormidium tenue* and *Calothrix* sp. were more frequent on the 2.4m. slides. *Stigeoclonium subsecundum* was the only one of the species under consideration common in the silt on the lower shelf, while none of them was found in the bottom silt. *Stigeoclonium subsecundum*, *Cladophora glomerata* and *Phormidium tenue*, however, appeared in cultures of silt from the lower shelf at a time when they were lacking in nature which suggests the presence of persisting individuals. The last species, as well as *Spirogyra* spp. and *Nostoc* sp. appeared in cultures of bottom silt.

ii. The following epiphytes were observed: —

Sometimes abundant	Sometimes common
<i>Achnanthes minutissima</i> var. <i>cryptocephala</i>	<i>Diatoma vulgare</i> var. <i>brevis</i>
<i>Cocconeis pediculus</i>	<i>D. vulgare</i> var. <i>producta</i>
<i>C. placentula</i>	<i>Achnanthes lanceolata</i>
<i>Gomphonema parvulum</i>	<i>Rhoicosphenia curvata</i>
<i>G. lanceolatum</i>	<i>Gomphonema constrictum</i>
<i>Chamaesiphon</i> sp.	

Except for the varieties of *Diatoma vulgare* and of *Cocconeis pediculus* which occurred principally on or among the marginal *Cladophora*, the others, usually regarded as epiphytes, occurred chiefly on the glass slides. *Achnanthes minutissima* var. *cryptocephala*, *Rhoicosphenia curvata*, *Gomphonema parvulum* and *G. constrictum* were found on the marginal 1 and 2.4m slides, while *Achnanthes lanceolata* and the species of *Cocconeis* were abundant on 1m. marginal and centre slides. In Windermere (Godward, 1937), *Cocconeis placentula*, is recorded as attaining a maximum at 3-4m, while *Gomphonema constrictum* was seldom found below 1m. The last species was the only epiphyte frequent in the samples of silt at the time of their collection. Others (*Cocconeis placentula*, *Achnanthes lanceolata*, *A. minutissima* var. *cryptocephala*, *Gomphonema parvulum*, *Chamaesiphon* sp.) however, subsequently became common in the cultures of silt from the lower shelf, while species of *Achnanthes*, *Gomphonema parvulum* and *G. constrictum* multiplied in the cultures of bottom silt with distilled water or nutrient solutions.

iii. The following bottom-living species occurred: —

Sometimes abundant	Sometimes common
<i>Fragilaria construens</i>	<i>Scenedesmus carinatus</i>
<i>Navicula cryptocephala</i>	<i>Cosmarium Botrytis</i>
<i>N. cincta</i>	<i>C. granatum</i> var. <i>subgranatum</i>
<i>Cymbella ventricosa</i>	<i>Melosira varians</i>
<i>Amphora ovalis</i>	<i>M. granulata</i>
<i>Nitzschia fonticola</i>	<i>Navicula gracilis</i>
<i>N. palea</i>	<i>N. exigua</i>
<i>N. holsatica</i>	<i>N. seminulum</i>
	<i>Nitzschia linearis</i>
	<i>N. amphibia</i>

All of these except the two *Melosiras*, *Fragilaria construens* and *Scenedesmus carinatus* are capable of movement. Some (*Navicula cincta*, *N. exigua*, *Nitzschia fonticola*) were most plentiful among the attached marginal growth, others (*Cosmarium Botrytis*, *Navicula cryptocephala*, *Cymbella ventricosa*) were conspicuous both here and on the marginal and centre slides. *Scenedesmus carinatus* was frequent among the marginal attached growth and on the centre slides, while the remaining species were more frequent on the slides, *Melosira varians* and *Nitzschia amphibia* on the centre slides, *Navicula seminulum* and *Fragilaria construens* on the marginal slides, the others being equally distributed on the slides.

F. construens, *Navicula cincta*, *N. gracilis* and *Amphora ovalis* were common in the silt of the lower shelf, but only the last, and *Melosira granulata* were frequent on the bottom silt. *M. granulata* was common on the 5.2m slides and in the deep plankton samples, and together with *Fragilaria construens*, *Navicula cryptocephala*, *Amphora ovalis*, *Cymbella ventricosa* and *Nitzschia palea* has been recorded elsewhere (Godward, 1937; Lund, 1942) as a bottom living form.

The poor growth of algae on the bottom silt may be due to light-deficiency, since several were common in the cultures. *Fragilaria construens*, *Navicula cincta*, *Amphora ovalis*, *Nitzschia palea*, *N. linearis*, and *N. recta* multiplied in cultures of silt from the shelf and from the bottom, while *N. sigmoidea* and *Campylodiscus noricus* were frequent in distilled water cultures of silt from the shelf. Several species (*Melosira granulata*, *Navicula cryptocephala*, *Cymbella ventricosa*, *Nitzschia fonticola*, *N. acuta*) were characteristic of the cultures of bottom silt, but others (*Melosira varians*, *Navicula exigua*, *N. seminulum* and *Cymatopleura solea*) only became frequent when a nutrient solution was used, or the nitrate content was raised.

VI. PERIODICITY.

i. *The phytoplankton.* In the two years there were marked differences in the plankton, that of 1937 (prior to the closing of the inlet) including numerous *Chlorophyceae*, while in 1938, diatoms and *Myxophyceae* were most important. These differences were reflected in the periodicity of the plankton and were particularly noticeable during winter and spring. The following phases can be distinguished: —

Winter (mid-December to end of February).

In 1936-37 *Carteria globosa*, *Fragilaria crotonensis* and *Nitzschia acicularis* were dominant, but in the following winters *Asterionella formosa* and *Stephanodiscus astraea* were important diatoms; in 1937-38 species of *Cryptomonas* played a considerable rôle.

Spring (March to May).

Carteria globosa, which caused a water bloom during February and

most of March of 1937, disappeared after zygotes had been formed. *Synedra acus* was abundant until the middle of May and was accompanied by *Nitzschia acicularis* and decreasing *Fragilaria crotonensis*. Towards the end of May these diatoms became rare or disappeared. The two species of *Scenedesmus* reached a maximum during May, while other green algae (*Pediastrum Boryanum*, *Oocystis lacustris*, *O. Naegelii*, *Quadrigula closterioides*, *Coelastrum microporum*, *Staurastrum paradoxum*) and *Anabaena flos aquae* began to appear in some numbers.

In 1938 the spring plankton consisted chiefly of diatoms, with *Asterionella formosa*, *Stephanodiscus astraea* and *Fragilaria capucina* attaining maxima. The two species of *Cryptomonas* were common for short periods, while *Planktosphaeria gelatinosa* was the only frequent green alga. The Myxophyceae were represented by *Anabaena flos aquae* and *Aphanizomenon flos aquae*.

Summer. (June to mid-September).

In 1937 the Chlorophyceae present in May became a dominant element in the plankton and were associated with *Coronastrum anglicum*, *Anabaena flos aquae*, *A. spiroides* and *Aphanizomenon flos aquae*. *Melosira granulata* var. *angustissima*, *Asterionella formosa* and *Fragilaria crotonensis* developed less conspicuous maxima while the two species of *Cryptomonas* were common.

In 1938 blue-green algae and diatoms formed the principal constituents of the summer plankton. *Planktosphaeria gelatinosa* and *Staurastrum paradoxum* being the only common green algae. The blue-green species were the same as in 1937, with the addition of a considerable amount of *Microcystis aeruginosa*; the Nostocaceae appeared earlier and were less abundant. The two species of *Fragilaria*, *Melosira granulata* var. *angustissima*, the two species of *Cryptomonas* and *Trachelomonas volvocina* were common for short periods during the summer.

Autumn (mid-September to mid-December).

There was the usual reduction in the number of species and individuals. *Closterium peracerosum* and the two species of *Cryptomonas* were sometimes common, and *Asterionella formosa* showed a small maximum. In 1938 *Staurastrum paradoxum*, *Fragilaria crotonensis*, *Stephanodiscus astraea*, *Melosira* var. *angustissima*, the two species of *Cryptomonas* and *Microcystis aeruginosa* were frequent; the last, which was associated with *Nitzschia palea*, developed a small maximum in October.

ii. *Non-planktonic algae.* The differences in the periodicity of the non-planktonic species were just as marked during the two years. *Cladophora* is practically always present, having shorter cells and a more tufted habit in winter than in summer. In the following summary the variations between the different habitats and depths are ignored: —

Winter.

Diatoms predominate. In 1936-37 the common species were *Cymbella ventricosa*, *Amphora ovalis*, *Nitzschia holsatica*, *N. linearis* and *N. palea*, but in 1937-38, species of *Nitzschia* were rare, while *Fragilaria construens*, *Achnanthes minutissima* var. *cryptocephala*, the species of *Cocconeis*, *Gomphonema parvulum* and *G. constrictum* played an important part, together with *Cymbella* and *Amphora*. In 1938-39 *Synedra ulna* var. *amphirrhynchus* was the most conspicuous species. The most frequent green alga in winter is *Stigeoclonium subsecundum*.

Spring.

In 1937 the species of *Nitzschia* decreased, while *Achnanthes minutissima* var. *cryptocephala* began to increase and *Cymbella ventricosa* and *Amphora ovalis* remained common. In 1938 these three species as well as *Gomphonemas*, *Navicula cincta* and *N. gracilis* were important. The only green growth was a little *Stigeoclonium subsecundum*, *Tetraspora* sp. and *Ulothrix* sp.

Summer.

In 1937 *Stigeoclonium subsecundum* was abundant and *Phormidium tenuie* strongly represented in July, but diatoms (species of *Cocconeis*, *Achnanthes minutissima* var. *cryptocephala*, *Navicula cryptocephala*, *Gomphonema parvulum*, *Cymbella ventricosa*, *Amphora ovalis*, *Nitzschia palea* and *N. fonticola*) were the most conspicuous algae. In 1938 there was a scantier growth of *Stigeoclonium subsecundum* and *Phormidium tenuie*, while *Cocconeis pediculus* and *Amphora ovalis*, as well as *Rhoicosphenia curvata*, *Gomphonema lanceolatum* and *G. constrictum* which were rare or absent in 1937, were common. *Chamaesiphon* was less frequent than in the preceding summer.

Autumn.

In 1937 the *Stigeoclonium* remained conspicuous, while *Fragilaria construens*, *Achnanthes minutissima* var. *cryptocephala*, the species of *Cocconeis*, *Amphora ovalis*, *Cymbella ventricosa*, *Nitzschia palea* and *Chamaesiphon* sp. were common at one time or the other, and *Navicula cincta*, *N. gracilis* and *Gomphonema parvulum* were not infrequent. In 1938 the amount of growth was far less, and the *Stigeoclonium* almost restricted to the centre slides. Various diatoms (*Melosira varians*, *Fragilaria construens*, *Synedra ulna* var. *amphirhynchus*, *Cocconeis pediculus*, *Gomphonema lanceolatum*, *Amphora ovalis*), though not abundant, were widely distributed.

VII. CORRELATION BETWEEN PERIODICITY AND VARIONS IN THE ENVIRONMENT.

The evidence suggests that the variations in the amount of light and in the concentrations of ammoniacal nitrogen, nitrate nitrogen, phosphate and silica (Fig. 2) are the most important factors in deter-

mining the periodicity of the algal growth in the reservoir (see Fig. 3). The concentrations of Ca, Mg, K, Na and Fe, which Chu (1942) found to be important, were not determined.

In the first place attention may again be drawn to the marked contrast in the phytoplankton between the two years. With the great reduction in nitrate nitrogen that followed the closing of the inflow, the Chlorophyceae which were conspicuous in 1937, became negligible (except for two desmids), while diatoms and blue-green algae played the most important rôle. This great difference between the two years, during which most of the observations were made, makes it difficult to draw many general conclusions as to the relation between chemical and physical factors and the algal flora.

The most striking changes in the environment occurred in early spring (March-April) and in early autumn. The spring algal maximum in the usual way reduced the supplies of nitrogen, phosphates and silica to very low levels and, although the two last soon increased again, the deficiency of nitrogen continued until September when there was an increase in ammoniacal nitrogen, followed by an increase in nitrates. The two dominant Myxophyceae, *Anabaena flos aquae* and *Aphanizomenon flos aquae* attained their maximum development in both years, when nitrate nitrogen was at its lowest and phosphates on the increase. The two species of *Closterium* and *Staurastrum* reach their maximum with the autumnal increase in phosphates when nitrates are still low, while the great development of epiphytic diatoms takes place in summer with increasing silica and phosphates; their representation is, however, in part certainly determined by the availability of suitable substrata. It is noticeable that the behaviour of the planktonic *Asterionella formosa* and *Stephanodiscus astraea* is different, since their maxima occur in early spring. The general conclusion may be drawn that the green algae (apart from the desmids) require a higher nitrate, but a lower phosphate content than do most of the diatoms, while the Myxophyceae tend to reach a maximum with increasing phosphate and negligible amounts of inorganic nitrogen.

The periodicity of several species may be correlated with the environmental factors in somewhat greater detail:

1. *Pediastrum Boryanum*. According to Chu (1943, pp. 115, 132), the lower limits of nitrate N and phosphate for optimum growth of this alga are 0.069¹⁾ and 0.024 respectively, the growth being favoured by prolonged illumination. In the reservoir the average contents of nitrate N (falling) and of phosphate (increasing) in the month preceding the 1937 maximum were 0.09 and 0.006 respectively, with an average of 5.8 hours daily sunshine. The decreasing nitrates and the initially low phosphates may have been two factors restricting the growth in the reservoir.

2. *Staurastrum paradoxum* according to Chu (1943, pp. 116, 118, 135)

¹⁾ Chemical data expressed as parts per 100,000.

grows best in cultures when the concentrations of nitrate N, ammoniacal N and phosphate are not less than 0.085, 0.26 and 0.024 respectively. In the reservoir this species was most frequent with nitrate N between 0.002 and 0.051 and the phosphates between 0.030 and 0.127, the amount of sunlight varying between 4.0 and 6.1 hours per day. The growth of *S. paradoxum* in the reservoir may therefore have been limited by the low concentration of nitrogen.

3. *Fragilaria crotonensis*. Chu (1942, p. 320; 1943, p. 123) found that the lower limits of ammoniacal N, phosphate and silica for optimum growth of this species were 0.026, 0.06 and 1.9 respectively; he also found that it grows equally well in media in which N containing salts are $(\text{NH}_4)_2\text{SO}_4$, NH_4Cl , or $\text{Ca}(\text{NO}_3)_2$. In the reservoir *F. crotonensis* was common in January 1937 and 1938 and in November 1938. The average concentration of N, phosphate and silica preceding these maxima varied between 0.20 and 0.005, 0.109 and 0.013, 1.8 and 0.9 respectively. Even at the time of its maximum growth in the reservoir, the frequency of *F. crotonensis* seems to have been limited by the low concentrations of nitrogen, phosphate or silica.

4. *Asterionella formosa*. According to Chu (1942, p. 322; 1943, pp. 124, 142) the lower limits of nitrate N, phosphate and silica for optimum growth of this species in culture are 0.050, 0.013 and 0.9 respectively. Its maximum in the reservoir occurred at concentrations varying between 0.04 and 0.06, 0.027 and 0.059, and 0.1 and 2.1 respectively, so that its degree of abundance may at times have been limited by the concentrations of nitrate and silica.

5. *Nitzschia acicularis* according to Chu grows best in cultures with a high nitrate content (0.68) and phosphate and silica contents of 0.1 and 0.9 respectively. In the reservoir it was only common when nitrate N was high (0.25) and concentrations of phosphate (0.007) and silica (1.1) were low. Although the phosphate and silica contents of the water were suitable at other times, the nitrate N content remained at or below 0.08 and *N. acicularis* never again became frequent.

6. *Nitzschia palea*. The lower limits of nitrogen, phosphate and silica for the optimum growth of this species in culture are 0.13 (ammoniacal or nitrate N), 0.005 and 0.9 respectively (Chu, 1942, p. 319; 1943, pp. 122, 140). Its maximum in the reservoir was preceded by concentration of nitrate N, ammoniacal N, phosphate and silica of 0.02, 0.09, 0.109 and 1.7 respectively, which suggests that during most of this investigation its development was limited by the low nitrogen content.

In the following, species common in the reservoir are grouped in relation to certain factors of the environment.

1. Species common when the nitrogen content is above 0.04: —

Carteria globosa

Pediastrum Boryanum

Oocystis lacustris

O. Naegelii

Stephanodiscus astraea

Fragilaria crotonensis

Synedra acus

Asterionella formosa

<i>Quadrigula closterioides</i>	<i>Achnanthes minutissima</i> var.
<i>Scenedesmus obliquus</i>	<i>cryptocephala</i>
<i>S. quadricauda</i> var. <i>longispina</i>	<i>Cocconeis pediculus</i>
<i>Coronastrum anglicum</i>	<i>C. placentula</i>
<i>Coelastrum microporum</i>	<i>Cymbella ventricosa</i>
<i>Stigeocladium subsecundum</i>	<i>Amphora ovalis</i>
<i>Closterium peracerosum</i>	<i>Nitzschia acicularis</i>
<i>C. aciculare</i> var. <i>subpronum</i>	<i>N. palea</i>
<i>Staurastrum paradoxum</i>	

Species common when the nitrogen content is below 0.03: —

<i>Pediastrum duplex</i> var. <i>clathratum</i>	<i>Aphanizomenon flos aquae</i>
<i>Planktosphaeria gelatinosa</i>	<i>Anabaena flos aquae</i>
<i>Melosira granulata</i> var. <i>angustissima</i>	<i>A. spiroides</i>
<i>Fragilaria capucina</i>	<i>Microcystis aeruginosa</i>
<i>Synedra ulna</i> var. <i>amphirhynchus</i>	

2. Species common when the phosphate content is above 0.011: —

<i>Pediastrum duplex</i> var. <i>clathratum</i>	<i>Melosira granulata</i> var. <i>angustissima</i>
<i>Planktosphaeria gelatinosa</i>	<i>Stephanodiscus astraea</i>
<i>Stigeocladium subsecundum</i>	<i>Fragilaria crotonensis</i>
<i>Staurastrum paradoxum</i>	<i>Synedra ulna</i> var. <i>amphirhynchus</i>
<i>Closterium peracerosum</i>	<i>Asterionella formosa</i>
<i>C. aciculare</i> var. <i>subpronum</i>	<i>Achnanthes minutissima</i> var.
<i>Aphanizomenon flos aquae</i>	<i>cryptocephala</i>
<i>Anabaena flos aquae</i>	<i>Cocconeis pediculus</i>
<i>A. spiroides</i>	<i>C. placentula</i>
<i>Microcystis aeruginosa</i>	<i>Cymbella ventricosa</i>
	<i>Amphora ovalis</i>
	<i>Nitzschia palea</i>

Species common when the phosphate content is below 0.01: —

<i>Carteria globosa</i>	<i>Oocystis lacustris</i>
<i>Scenedesmus obliquus</i>	<i>O. Naegelli</i>
<i>S. quadricauda</i> var. <i>longispina</i>	<i>Coronastrum anglicum</i>
<i>Pediastrum Boryanum</i>	<i>Fragilaria capucina</i>
<i>Quadrigula closterioides</i>	<i>Synedra acus</i>
<i>Coelastrum microporum</i>	<i>Nitzschia acicularis</i>

3. Species common when the silica content is above 1.5: —

<i>Stephanodiscus astraea</i>	<i>Cocconeis pediculus</i>
<i>Fragilaria crotonensis</i>	<i>C. placentula</i>
<i>Synedra ulna</i> var. <i>amphirhynchus</i>	<i>Cymbella ventricosa</i>
<i>Asterionella formosa</i>	<i>Amphora ovalis</i>
<i>Achnanthes minutissima</i> var.	<i>Nitzschia palea</i>
	<i>cryptocephala</i>

Species common when the silica content is below 1.4: —

<i>Melosira granulata</i> var. <i>angustissima</i>	<i>Synedra acus</i>
<i>Fragilaria capucina</i>	<i>Nitzschia acicularis</i>

4. Species common when the hours of daily sunshine exceed 4: —

<i>Pediastrum Boryanum</i>	<i>Stephanodiscus astraea</i>
<i>P. duplex</i> var. <i>clathratum</i>	<i>Fragilaria capucina</i>
<i>Quadrigula closterioides</i>	<i>Achnanthes minutissima</i> var.
<i>Scenedesmus obliquus</i>	
<i>S. quadricauda</i> var. <i>longispina</i>	<i>cryptocephala</i>

Coelastrum microporum

Oocystis lacustris

O. Naegelii

Coronastrum anglicum

Planktosphaeria gelatinosa

Staurastrum paradoxum

Cocconeis pediculus

C. placentula

Amphora ovalis

Anabaena flos aquae

A. spiroides

Species common when the hours of daily sunshine are less than 4: —

Carteria globosa

Closterium peracerosum

C. aciculare var. *subpronum*

Synedra acus

S. ulna var. *amphirhynchus*

Asterionella formosa

Fragilaria crotonensis

Cymbella ventricosa

Nitzschia palea

Aphanizomenon flos aquae

Microcystis aeruginosa

VIII. SPECIES NEW TO THE BRITISH FLORA.

A number of species, including a new species and a new variety, hitherto not recorded for Great Britain, were encountered in the course of the investigation. They were found in the centrifuged samples and belong to the nannoplankton.

1. *Coronastrum anglicum* n. sp (Fig. 4 A-D). Coenobia minute ($5\text{-}8 \mu$ apart), grouped in one plane and connected by small pads of mucilage composed of four oval cells ($3.8\text{-}5.2 \mu$ long, 2.5μ wide, 1.6μ thick); cells with a thin and colourless wall, bearing a hyaline mucilaginous horn (4.8μ long) and containing a parietal chloroplast, with a single pyrenoid surrounded by a starch sheath, situated on the outer face of the cell. Multiplication by the simultaneous division of the four cells of a coenobium, the four daughter coenobia sometimes cohering for some time.

C. anglicum is very similar to *C. aestivale* R. H. Thompson (1938) but the cells are oval, somewhat smaller and not so widely spaced in the coenobium. It has also been found in the Walthamstow and Island Barn Reservoirs of the Metropolitan Water Board in 1941 and 1942 respectively.

2. *Scenedesmus arcuatus* Lemm. (?) var. *irregularis* nov. var. (Fig. 4E). Aggregates pelagic, composed of a variable number of oval cells ($10\text{-}14 \mu$ long, $6\text{-}10 \mu$ wide), arranged in more than one plane, the cells usually grouped in pairs, with the adjacent sides flattened, so that their shape is somewhat like that of an *Ecdysichlamys* (West, 1912, p. 76). There is usually a simple parietal chloroplast, with a pyrenoid surrounded by a starch sheath, leaving the ends of the cells free. In preserved material the wall of the larger cells may show a slight polar thickening. The cells divide transversely. In the smaller colonies the cells are surrounded by a close-fitting envelope, but in the larger ones, this breaks down at one or more points, its edges projecting freely. The reference of this alga to *Scenedesmus arcuatus* is uncertain.

3. *Planktosphaeria gelatinosa* G. M. Smith (Fig. 4, F, G). This alga occurred as solitary, spherical cells ($10\text{-}46 \mu$ in diameter, usually $13\text{-}20 \mu$), with a moderately thick colourless wall, enveloped by a

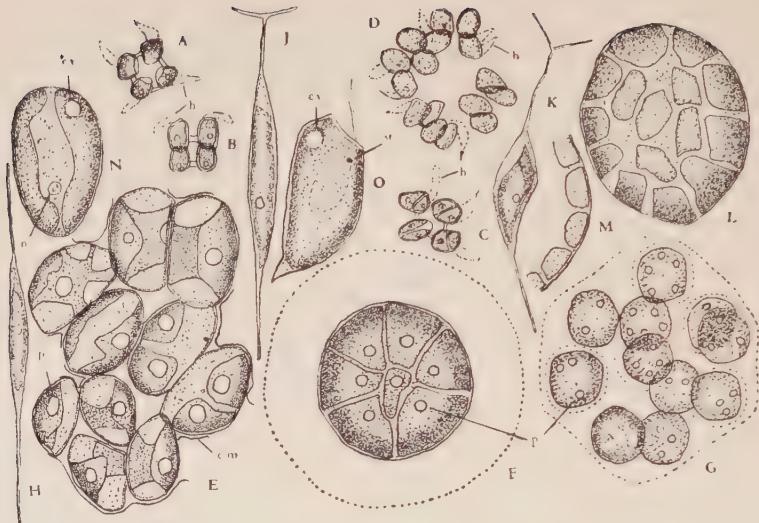


Fig. 4. Species new to British flora. A-D *Coronastrum anglicum* n. sp. A, in surface view. B, in lateral view. C-D, stages in division. E. *Scenedesmus arcuatus* Lemm. var. *irregularis* nov. var. F-G. *Planktosphaeria gelatinosa* G. M. Smith. F, surface view of single cell, G, stages in division. H. *Schroederia setigera* (Schröd.) Lemm. J-K. *Characium ancora* (G. M. Smith) Fott. L-M. *Oocystis eremosphaeria* G. M. Smith. forma. L, in surface view, M, in optical section. N-O. *Cryptomonas* sp. N, in dorsal view. O, in lateral view. cm common membrane, cv contractile vacuole. h mucilage horn. n nucleus. p pyrenoid. st stigma. Magnification, G X 500, the rest X 1000.

wide zone of hyaline, non-laminated mucilage ($19.5-175.0 \mu$ wide, usually $19.5-28.0 \mu$ wide). The mature cells contain a number of parietal wedge-shaped chloroplasts, projecting into the interior of the cell and including near their inner end a pyrenoid with a well-defined starch sheath. Division into eight or more cells was observed on two occasions. The young cells contain only a few parietal chloroplasts which are not wedge-shaped. The British form of the alga differs from that described by Smith (1918, p. 627; 1920, p. 103) in the usual occurrence of solitary cells.

4. *Schroederia setigera* (Schröd.) Lemm. (Fig. 4 H) occurred rarely in the nannoplankton as solitary spindle-shaped cells, (41.51μ long with the spines and $2.5-5.0 \mu$ wide) tapering at either end into a colourless spine, the narrower cells being commoner than the wider ones. The parietal chloroplast contains a single pyrenoid.

5. *Characium ancora* (G. M. Smith) Fott (Fig. 4. J, K) *Schroederia setigera* Schröd var. *ancora* G. M. Smith (1926, p. 183), regarded by the author subsequently (1933, p. 508) as a separate species, occurred as solitary, free-floating, spindle-shaped cells ($38-51 \mu$ long, $2.5-5.1 \mu$ broad), sometimes bent or twisted. One of their terminal spines is

bifurcate at the end, which is Y or T-shaped, the distance between the tips sometimes being as much as $10\text{ }\mu$. In Smith's specimens the branches of the bifurcations were recurved, but such individuals were not seen by me. There is a single chloroplast with a pyrenoid. No stages in reproduction were found.

Fott (1942) has given good reason for regarding this alga as a pelagic species of *Characium* (*C. ancora* (G. M. Smith) nov. comb.) and refers the closely related *Schroederia Judayi* G. M. Smith (1916, p. 474; 1920, p. 137) to *Characium gracile* Schiller. For the former he describes reproduction by means of zoospores.

6. *Oocystis eremosphaeria* G. M. Smith forma (Fig. 4 L, M). The solitary cells were oval ($26\text{-}28\text{ }\mu$ long, $19\text{-}23\text{ }\mu$ wide), with a relatively thin, colourless wall; a mucilage envelope was usually lacking. Each cell contained numerous parietal polygonal chloroplasts, with pyrenoids showing a well-marked starch-sheath; in optical section (Fig. 4 M) the inner contour of the chloroplasts is rounded. This form differs from that described by Smith (1918, p. 630; 1920, p. 113) in the smaller cells and the absence of polar thickenings of the wall.

c. *Cryptomonas* sp. (Fig. 4 N, O). The cells ($19\text{-}23\text{ }\mu$ long, $8.4\text{-}12.0\text{ }\mu$ wide) are somewhat flattened, with an emarginate anterior end produced on the dorsal side, and a more or less curved posterior end which tapers to a hyaline point and is only visible in the lateral view. The flagella are about half as long as the body ($11\text{-}12\text{ }\mu$ long). The periplast is thin and colourless. The yellow-brown chromatophores lack pyrenoids and are situated on the flanks of the cell, while the gullet extends to about the middle and is lined with numerous trichocysts. The nucleus is near the posterior end and a stigma, which only becomes evident after staining with iodine, is near the anterior end. The relatively conspicuous vacuole lies dorsal to the gullet. This form resembles *C. Marssonii* Skuja (1948, p. 357), but differs from it in the position of the chromatophores, the presence of a stigma and the greater flattening of the cell. It has not been sufficiently studied to warrant the establishment of a distinct species.

IX. SUMMARY.

- i. The results of a continuous investigation of the algal flora of a water reservoir over a period of two years are given. The flora includes a littoral community (chiefly represented by *Cladophora glomerata*), the phytoplankton, and a number of bottom-living species.
- ii. The plankton includes a considerable number of species which are typical of the pelagic plankton of lakes, but there are in addition a number of species which are essentially littoral in their usual occurrence (e.g. *Pediastrum Boryanum*, *Scenedesmus* spp., *Nitzschia acicularis*). Many phytoplankton species are derived from the supply water of the River Thames (e.g. *Staurastrum paradoxum*, *Stephano-*

discus astraea, *Fragilaria* spp., *Microcystis aeruginosa*), but other important forms are lacking in the river and must have been introduced from other sources (e.g. *Quadrigula closterioides*, *Coelastrum microporum*, *Anabaena* spp., *Aphanizomenon flos aquae*).

iii. The only perennial forms in the plankton were *Cryptomonas ovata*, *Pediastrum Boryanum*, *Fragilaria cotonensis* and *Asterionella formosa*. *Carteria globosa*, *Staurastrum paradoxum*, *Anabaena* spp. and *Aphanizomenon flos aquae* produced spores, but the majority formed no obvious resting stages and no doubt persisted as occasional individuals.

iv. Evidence is given for the view that *Scenedesmus* spp., *Coelastrum microporum*, *Fragilaria capucina*, *Nitzschia acicularis* and *Anabaena* spp. persisted from one period of occurrence to the other in the silt. The same may be true of *Carteria globosa*, the species of *Pediastrum*, *Oocystis* and *Closterium*, *Planktosphaeria gelatinosa*, *Staurastrum paradoxum*, *Melosira granulata* var. *angustissima*, *Fragilaria cotonensis*, *Synedra acus*, *Microcystis aeruginosa* and *Aphanizomenon flos aquae*, but the evidence is not so satisfactory.

v. The plankton differed very markedly in the two years, in 1937 including numerous Chlorophyceae, in 1938 consisting largely of diatoms and Myxophyceae. These differences can be correlated with the closure of the inlet to the reservoir in March 1937 which resulted in marked changes in the chemical components of the water.

vi. The periodicity shown by the algal flora can, in part, be correlated with changes in the amount of light, and the concentrations of nitrogen, phosphate, and silica in the water. In winter diatoms were conspicuous, although the dominant species were different in the three winters. The diatoms attained their maximum growth in spring, the important species in 1937 being *Synedra acus* and *Nitzschia acicularis*, in 1938 *Stephanodiscus astraea* and *Asterionella formosa*. In the summer of 1937 Chlorophyceae were conspicuous and were followed by Myxophyceae, but in 1938 the former were rare, and the Myxophyceae phase succeeded immediately upon that of the pelagic diatoms. During the summer the nitrate content was negligible, while phosphates and silica increased. The autumn phase, characterised by the presence of a few diatoms and desmids, accompanied an increase first of ammoniacal nitrogen and later of nitrate nitrogen.

vii. The Chlorophyceae (apart from desmids) of the plankton appear to require higher nitrogen and lower phosphate contents than do the diatoms, while the blue-green algae attain their chief development when the concentration of phosphate is high and the amount of inorganic nitrogen negligible.

The author would thank especially Prof. F. E. Fritsch for his help and advice, the late Mr. A. C. Gardiner for identifying the zooplankton, the staff of the Metropolitan Water Board and Dr. P. H. De for analyses of the silt.

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TABLE 1
OCCURRENCE OF COMMONER CONSTITUENTS OF THE
PHYTOPLANKTON

(abs. = absent; C = centre plankton samples or slides; G = equally distributed in plankton samples or slides; m = marginal plankton samples or slides; VR = very rare).

	SURFACE SAMPLES OF PLANKTON						DISTRIBUTION ON SLIDES	
	Position and Month of maximum Frequency		First seen		Last seen			
	'37	'38	'37	'38	'37	'38	'37	'38
A. SPECIES sometimes ABUNDANT.								
<i>Carteria globosa</i> Korsch	G 2-3	abs.	— ¹⁾	abs.	G	abs.	m	abs.
<i>Stephanodiscus astraea</i> (Ehrenb.) Grun.	VR	G 3	G	m	persists	VR	C	
<i>Synedra acus</i> (Kütz.) Grun.	G 4-5	VR	— ¹⁾	G	m	m	G	VR
<i>Anabaena flos aquae</i> (Lyng.) Bréb.	m 7	m 5	m	G	C	G	VR	VR
<i>Aphanizomenon flos aquae</i> (L.) Ralfs.	G 7	m 6	G	m	G	G	VR	VR
B. SPECIES sometimes COMMON.								
<i>Phacotus lenticularis</i> Stein	C 6	VR	m	m	C	G	C	VR
<i>Pediastrum Boryanum</i> (Turp.) Menegh.	C 5	VR	G	persists			m	VR
<i>P. duplex</i> Meyen var. <i>clathratum</i> A. Br.	C 7	VR	G	C	m	m	VR	VR
<i>Planktosphaeria gelatinosa</i> G. M. Smith	VR	m 7	m	G	m	G	VR	VR
<i>Oocystis lacustris</i> Chod.	C 6	VR	G	G	m	G	C	VR
<i>O. Naegelii</i> A. Br.	C 6	VR	G	persists			G	VR
<i>O. eremosphaeria</i> G. M. Smith	m 12	VR	G	G	m	C	VR	VR
<i>Quadrigula closterioides</i> (Bohlin) Printz.	C 5	VR	G	m	G	G	VR	VR
<i>Scenedesmus obliquus</i> (Turp.) Kütz.	G 5	VR	G	m	C	m	G	VR
<i>S. quadricauda</i> (Turp.) Bréb. var. <i>longispina</i> Lauther	G 5	VR	G	m	m	m	m	VR
<i>Coronastrum anglicum</i> n. sp.	G 6	abs.	G	abs.	m	abs.	VR	abs.
<i>Coelastrum microporum</i> Naeg.	m 5	VR	C	m	m	G	m	C
<i>Closterium peracerosum</i> Gay	m 11	VR	m	m	m	G	VR	VR
<i>C. aciculare</i> T. West var. <i>subpronum</i> W. & G.S. West.	G 11	m 11-12	m	G	m	persists	C	VR
<i>Staurastrum paradoxum</i> Meyen	G 8	G 6-7)	C	persists			VR	C
<i>Staurastrum paradoxum</i> Meyen	—	G 9-10)						
<i>Melosira granulata</i> (Ehrenb.) Ralfs var. <i>angustissima</i> Müll.	m 7	C 7						
<i>Melosira granulata</i> (Ehrenb.) Ralfs var. <i>angustissima</i> Müll.	—	G 8	G	persists			VR	C
<i>Melosira granulata</i> (Ehrenb.) Ralfs var. <i>angustissima</i> Müll.	—	G 11)						
<i>Fragilaria capucina</i> Desm.	abs.	G 5	abs.	G	abs.	G	abs.	G
<i>F. crotonensis</i> (A. M. Edw.) Kitton	G 1	m 7						
<i>F. crotonensis</i> (A. M. Edw.) Kitton	m 7	m 11)			persists		G	VR
<i>Asterionella formosa</i> Hass.	m 7	G 2)						
<i>Asterionella formosa</i> Hass.	G 11	G 5	G	persists			C	VR
<i>Nitzschia acicularis</i> W. Smith	G 2-3)	VR	— ¹⁾	m	m	m	m	VR
<i>Nitzschia acicularis</i> W. Smith	G 5	—						
<i>Cryptomonas ovata</i> Stein	G 6-8	m 4						
<i>Cryptomonas ovata</i> Stein	G 11	m 7			persists		VR	VR
<i>Cryptomonas ovata</i> Stein	—	m 9						
<i>Cryptomonas</i> sp.	G 7-8)	G 8)						
<i>Cryptomonas</i> sp.	G 11)	—	G	persists			VR	VR
<i>Trachelomonas volvocina</i> Ehrenb.	VR	G 7	m	persists			VR	VR
<i>Microcystis aeruginosa</i> Kütz.	VR	m 10	G	G	G	G	VR	VR
<i>Anabaena spiroides</i> Klebahn	m 8)	VR	G	G	C	G	m	VR
<i>Anabaena spiroides</i> Klebahn	C 9)	—	G	G	C	G		

¹⁾ Already present when investigation started.

A propos de quelques espèces du genre Trachelomonas Ehrbg. et du genre Strombomonas Defl. trouvées aux Pays-Bas

II

par A. MIDDLEHOEK.¹⁾

Trachelomonas curta DA CUNHA =

Tr. volvocina var. compressa DREZ. (DEFLANDRE 1926)

Pl. I, f. 1.

Loge sphéroïdale (plus large que longue). Pore légèrement épaissi en anneau.

Membrane lisse, rouge-brun clair.

Chromatophores discoïdes 10-12.

Flagelle \pm 2 fois la long. du corps.

Stigme en forme de bâtonnet.

Peu commun.

Long. 22 μ , larg. 26 μ .

Almelo, 30/5/46.

Driene 9/10/45.

Trachelomonas volvocinopsis SWIRENKO.

Pl. I, f. 2.

Loge exactement sphérique.

Pore sans épaissement anulaire.

Membrane lisse, brun clair.

Chromatophores discoïdes 10.

Flagelle \pm 2 fois la long. du corps.

Stigme en forme de bâtonnet.

Commun.

Dim. 16-19 μ .

Enschede „t Stokhorst” 29/2/46.

Amersfoort 24/3/46.

Ootmarsum 25/8/46.

Baarn 7/11/48.

Trachelomonas Stokesi DREZ.

Pl. II, ff. 11, 12, 15, 16.

Loge ovoïde, pôle antérieur largement arrondi, pôle postérieur légèrement atténué.

¹⁾ Première partie voir Hydrobiologia I, 78-89, 1948.

Pore le plus souvent sans épaissement annulaire.

Membrane relativement épaisse, accroissant avec l'âge, ponctuée finement ou fortement, brun-jaune foncé.

Chromatophores discoïdes 12 (?).

Stigme présent.

Dim. très variable, long. 20-30 μ , larg. 17-28 μ .

Amersfoort 24/3/46.

Enschede „t Stokhorst” 29/2/46.

Enschede „de Kolk” 16/10/45.

Trachelomonas pulcherrima PLAYFAIR.

Pl. I, ff 3, 4.

Loge ellipsoïdale, très allongée avec pôles largement arrondis, côtes le plus souvent différemment arquées.

Pore avec un col bas, droit ou un peu oblique.

Membrane lisse, brun-jaune clair.

Chromatophores discoïdes, nombreux.

Stigme présent.

Flagelle 1 fois la long. du corps.

Long. avec col 25-27,5 μ , larg. 12-15 μ .

Pas commun.

Lattrop „Gele beek” 31/3/48.

Oldenzaal 27/8/49.

Trachelomonas lacustris DREZ.

Pl. I, f. 6.

Loge cylindrique, pôle antérieur un peu aplati, pôle postérieur largement arrondi.

Pore sans épaissement annulaire, sans col.

Membrane ponctuée ou avec papilles très courtes, jaune-brun clair.

Chromatophores discoïdes, nombreux.

Flagelle \pm 1½ fois la long. du corps.

Stigme présent.

Long. 28,5 μ , larg. 15 μ .

Pas commun.

Enschede 25/6/46.

Utrecht 8/5/46.

Driene 9/10/45.

Trachelomonas Sydneyensis PLAYFAIR.

Pl. V, ff. 26, 27.

Loge ellipsoïdale, parfois ovoïde allongée, à pôles arrondis, ornée d'épines pointues, réduites dans la région équatoriale.

Pore avec un col épineux.

Membrane jaunâtre clair, mince, flexible et déformable, non cassante.

Chromatophores grands à contour irrégulier.

Stigme long.

Flagelle 2 fois la long. du corps.

Pas commun.

Long. 38-40 μ , larg. 25-27 μ .

Amersfoort 24/3/46.

***Trachelomonas superba* SWIRENKO.**

Pl. V, f. 25.

Loge parfaitement ellipsoïdale, munie d'épines assez distantes, coniques et de longueur très variable.

Pore sans épaississement annulaire, avec ou sans col bas denticulé-crenelé.

Membrane finement ponctuée, rouge-brun clair, luisant.

Chromatophores discoïdes 12-16.

Stigme grand en forme de bâtonnet.

Flagelle $\pm 1\frac{1}{2}$ fois la long. du corps.

Long. 41-53 μ , larg. 34 μ .

Amersfoort 24/3/46, pas rare.

***Trachelomonas superba* forma *inevoluta* DEFL.**

Pl. IV, f. 20.

Forme sans épines.

Long. 60 μ , larg. 38 μ !

Parmi le type.

Amersfoort 24/3/46.

***Trachelomonas superba* var. *duplex* DEFL.**

Pl. III, ff. 18, 19.

Epines antérieures et postérieures plus longues que les épines médianes.

Long. 52 μ , larg. 40 μ .

Enschede „t Stokhorst” 29/2/46.

***Trachelomonas superba* var. *Swirenkiana* DEFL.**

Pl. IV, f. 21.

Epines postérieures plus longues.

Long. 53 μ , larg. 35 μ .

Amersfoort 24/3/46, parmi le type.

Les exemplaires sont remarquables par leurs épines très robustes.

***Trachelomonas armata* (EHR.) STEIN.**

Pl. II, ff. 13, 14, 17.

Loge ellipsoïdale ou ovoïde, pôles largement arrondis, pôle postérieur muni d'une couronne d'épines fortes, recourbées.

Pore pourvu d'un col bas, denticulé-crenelé.

Membrane lisse ou finement ponctuée, hyaline, brun-jaune.

Chromatophores discoïdes, nombreux et grains de paramylon.

Stigme présent.

Long. 38-47 μ , larg. 30-34 μ .
Enschede „Aamsveen” 25/7/46, pas rare.
Delden 7/10/46.
Glanerbrug 21/8/46.

Trachelomonas Lefevrei DEFL.

Pl. V, ff. 28, 29, 30.

Loge largement ellipsoïdale, cotés un peu arqués, pôles largement arrondis.

Pore toujours pourvu d'un col peu élevé, subcylindrique, à bord irrégulièrement crenelé.

Membrane scrobiculée ou obscurement ponctuée, assez épaisse ! parfois amincie à la partie postérieure, brun-jaune, brun-rouge foncé. Chromatophores 10, à peu près polyédriques et grains de paramylon. Stigme probablement absent, je n'ai pu distinguer un stigme chez aucun exemplaire !

Pellucide striée finement.

Flagelle 1 $\frac{1}{2}$ la long. du corps.

Long. 30 μ , larg. 22 μ .

Amsterdam „Zuiderzeepark”, en masse, 29/9/48.

DEFLANDRE n'écrit : „Le *Trachelomonas* dessiné et décrit dans votre lettre est bien le *Tr. Lefevrei*. Je viens de vérifier sur une préparation ancienne, le nombre des chromatophores (qui sont encore visibles.) Pour ce qui est de l'absence de stigme, je ne puis rien dire, car je ne me souviens pas avoir vu cette espèce vivante.”

Trachelomonas hexangulata (SWIRENKO), PLAYFAIR =
Tr. ampullula, PLAYFAIR.

Pl. I, ff. 9,10.

Loge en vue frontale subhexagonale à angles arrondis, côtes légèrement arquées.

Pore avec épaississement annulaire assez élevé, col droit, cylindrique.

Membrane lisse, brun clair ou violet.

Chromatophores discoïdes, nombreux.

Stigme présent.

Flagelle une fois la long. du corps.

Long. avec col 30 μ , larg. 17 μ .

Hauteur du col 4 μ , larg. 4-5 μ .

Pas rare.

Enschede „t Amelink” 12/4/46.

Trachelomonas Playfairi, DEFLANDRE.

Pl. V, ff. 22, 23, 24, Pl. I, f. 7.

Loge ellipsoïdale ou ovoïde, avec pôles largement arrondis, parfois le pôle postérieur légèrement atténué.

Pore toujours avec un col courbé.

Membrane lisse, brun foncé.

Chromatophores 10-16, discoïdes ou subpolyédriques et grains de paramylon.

Stigme présent.

Flagelle 2 fois la long. du corps; le plan de séparation fait un angle de presque 30° avec l'axe longitudinal de la loge.

Long. 23μ , larg. 19μ , hauteur du col 5μ .

Amsterdam „Artis”, 3/11/48.

Amersfoort 24/3/46.

Oldenzaal 17/7/48.

Trachelomonas bulla, STEIN =

Tr. pseudobulla, SWIRENKO.

Pl. I, ff. 5, 8.

Loge ellipsoïdale légèrement atténuée à la partie postérieure, pourvue de boutons obtus placés irrégulièrement,

Membrane un peu scabre, jaune-brun clair.

Pore coiffé d'un large col conique, ornémenté comme la loge, à bord irrégulièrement denticulé-crénelé.

Chromatophores discoïdes, nombreux.

Stigme présent.

Flagelle une fois la long. du corps.

Long. avec col $41-47,5\mu$, larg. $24,5\mu$, hauteur du col $7,6\mu$

Lattrop „Gele Beek” 31/3/48, commun.

EXPLICATION DES FIGURES.

PLANCHE I.

Fig. 1.

Trachelomonas curta DA CUNHA.

Almelo 30/5/46.

Vue frontale avec la cellule.

Fig. 2.

Trachelomonas volvocinopsis SWIRENKO.

Enschede 29/2/46.

Vue frontale avec la cellule.

Fig. 3, 4.

Trachelomonas pulcherrima PLAYFAIR.

Lattrop 31/3/48.

4. Vue frontale avec la cellule.

3. Coupe optique médiane.

Fig. 5, 8.

Trachelomonas bulla STEIN.

Lattrop 31/3/48.

5. Vue frontale.

8. Coupe optique médiane avec la cellule.

Fig. 6.

Trachelomonas lacustris DREZ.

Glanerbrug 21/8/46.

6. Vue frontale.

Fig. 7.

Trachelomonas Playfairi DEFLANDRE.

Amsterdam 3/11/48.

7. Coupe optique médiane avec plan de séparation.

Fig. 9, 10.

Trachelomonas hexangulata (SWIRENKO) PLAYFAIR.

Enschede 12/4/46.

9. Coupe optique médiane avec la cellule.

10. Coupe optique médiane.

PLANCHE II.

Fig. 11, 12, 15, 16. *Trachelomonas Stokesi* DREZ.

Enschede 29/2/46.

11. Vue frontale.

12. Vue frontale.

15. Vue frontale.

16. Vue frontale, vieil individu.

Fig. 13, 14, 17.

Trachelomonas armata (EHR.) STEIN.

Enschede 2,7/46.

13. Vue frontale.

14. Pore, vue apicale.

17. Coupe optique médiane avec la cellule.

PLANCHE III.

Fig. 18, 19.

Trachelomonas superba var. *duplex* DEFL.

18. Vue frontale.

19. Coupe optique médiane avec la cellule.

PLANCHE IV.

Fig. 20.

Trachelomonas superba forma *inevoluta* DEFL.

Vue frontale (Amersfoort 24/3/46).

Fig. 21.

Trachelomonas superba var. *Swirenkiana* DEFL.

Vue frontale (Amersfoort 24/3/46).

PLANCHE V.

Fig. 22, 23, 24.

Trachelomonas superba var. *duplex* DEFL.

22. Vue frontale (Amersfoort 24/3/46).

23. Vue frontale avec la cellule (Amersfoort 24/3/46).

24. Coupe optique médiane avec la cellule

(Oldenzaal 17/7/48).

Fig. 25.

Trachelomonas superba forma *inevoluta* DEFL.

Amersfoort 24/3/46.

Vue frontale.

Fig. 26, 27.

Trachelomonas superba var. *Swirenkiana* DEFL.

Amersfoort 24/3/46,

26. Pore.

27. Vue frontale avec la cellule.

Fig. 28, 29, 30.

Trachelomonas Lefevrei DEFLANDRE.

Amsterdam 29/9/48.

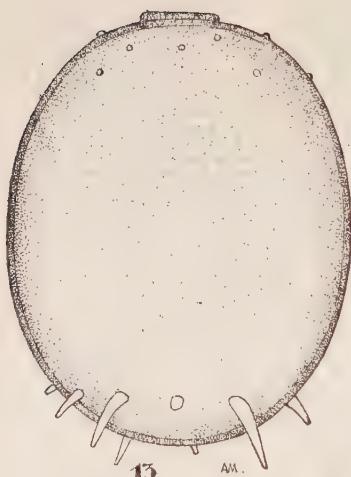
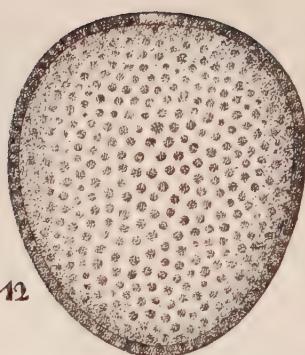
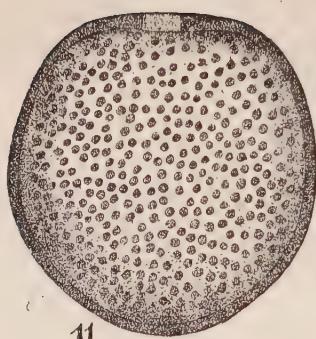
28. Vue frontale.

29. Coupe optique médiane avec la cellule.

30. Coupe optique médiane avec plan de séparation.



Planche I



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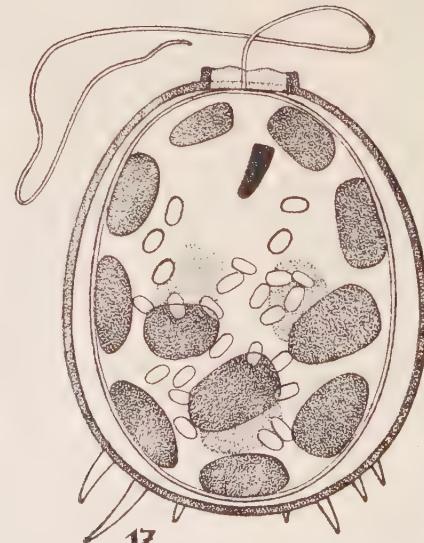
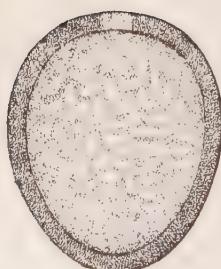
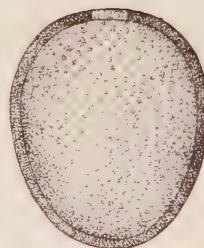


Planche II

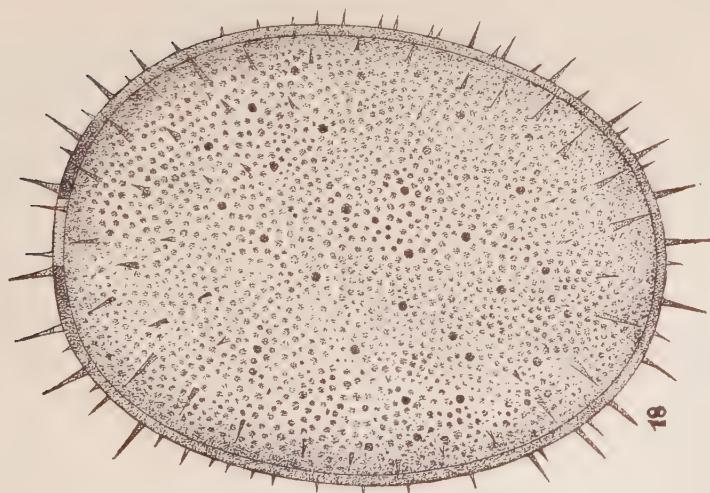
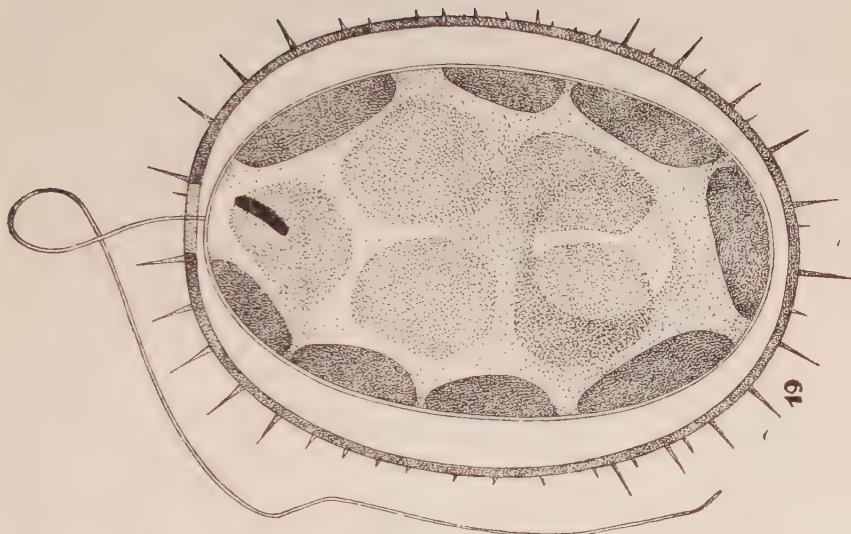
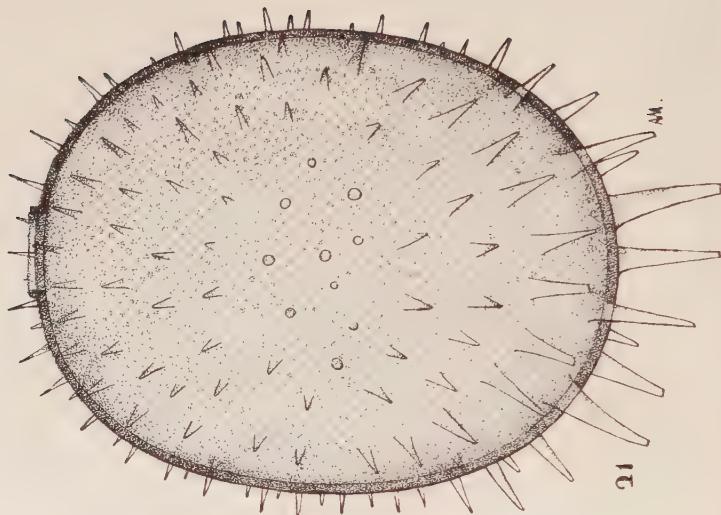
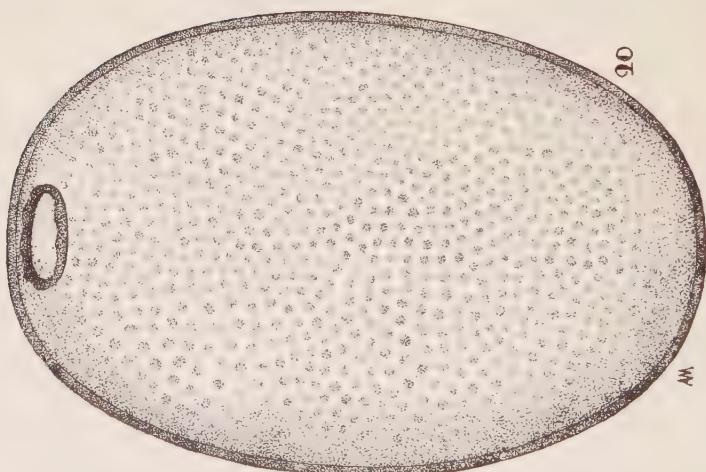


Planche III



21

M.



22

M.

Planche IV

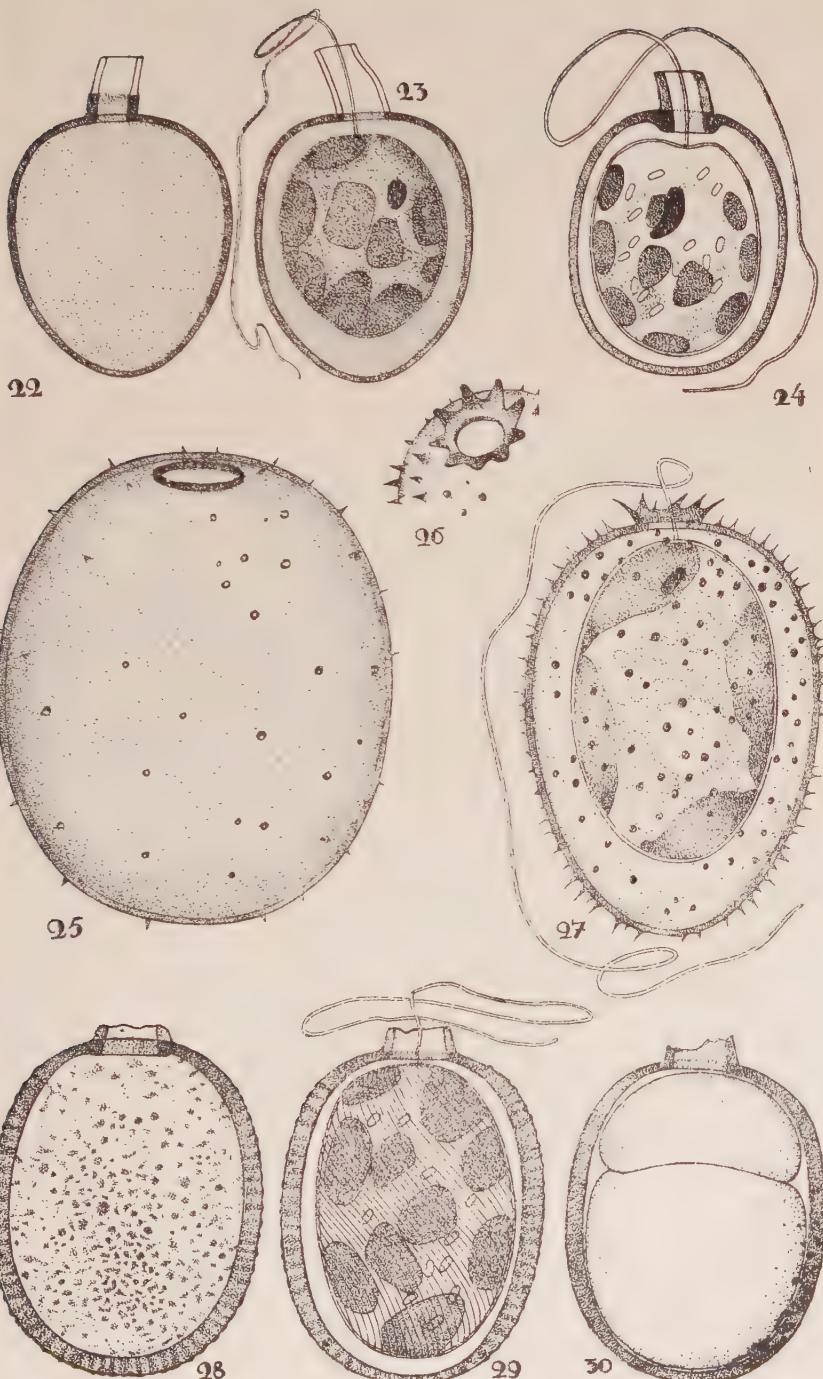


Planche V

Generic names of algae proposed for conservation

by

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In connection with studies of the marine algae of the Pacific coast of North America, several old and well-established generic names have been found to be illegitimate. In view of the forthcoming Seventh International Botanical Congress to be held at Stockholm in 1950, it seems timely to propose these names for conservation.

CHLOROPHYCOPHYTA

TRENTPOHLIA Martius (*Trentepohliaceae*), Fl. crypt. erlang. 351. 1817. Non *Trentepohlia* Böckeler, Bot. Zeit. 16: 249, 1858; nec *Trentepohlia* Pringsheim, Beitr. Meeres-Alg. 29. 1862.

versus

Trentepohlia Roth, Ann Bot. [Usteri] 10: 52. 1794. Non *Trentepohlia* Roth, Cat. bot. 2: 73. 1800.

Type species: *Trentepohlia aurea* (L.) Martius, loc. cit.

Martius established *Trentepohlia* to receive *Byssus aurea* Linnaeus (1753: 1168). At the time of publication, however, there existed two homonyms. The first genus to bear the name *Trentepohlia* was founded by Roth (1794) on a moss, which he named *T. erecta*. Later, following the opinion of Schrader, Roth (1800a: 232) decided that *T. erecta* was merely a sterile plant of *Bryum annotinum* (L.) Hudson (1762: 414). He then (1800b: 73) established a second *Trentepohlia*, based on two cruciferous species, *T. pinnata* and *T. integrifolia*, which have since been reunited with *Heliophila* Linnaeus (1763: 926). In recent times bryologists have identified Roth's *Trentepohlia erecta* (= *Bryum annotinum* as interpreted by Roth) as distinct from *Mnium annotinum* Linnaeus (1753: 1111). Correns has placed it in *Webera* Hedwig (1782: 95) as *W. Rothii* Correns (in Limpricht, 1902: 728), the binomial *W. erecta* being preoccupied.

Trentepohlia Martius first became firmly established in algological literature through the work of C. Agardh (1824: xxii, 36), who included in it not only *T. aurea* but three unrelated species, viz.: *T. purpurea*, *T. pulchella*, and *T. aeruginosa*. *T. purpurea* was based on *Byssus purpurea* Lightfoot (1777: 1000), now known as *Rhodo-*

chortum purpureum (Lightf.) Rosenvinge (1900: 75), the type species of its genus. *T. pulchella* was based on *Conferva Hermanni* Roth (1797: 164), now known as *Audouinella Hermanni* (Roth) Duby (1830: 972), the type species of its genus. *T. aeruginosa* is a freshwater species whose identity is uncertain. Simultaneously C. Agardh proposed the genus *Chroolepus* (1824: xxi, 34) to include several plants closely related to *Trentepohlia aurea*, viz.: *Byssus Jolithus* Linnaeus (1753: 1169); *Conferva odorata* (Wiggers) Lyngbye (1819: 164, pl. 57D); *Conferva lichenicola* J. E. Smith (in Eng. Bot., 1806, pl. 1609); *Conferva rubicunda* Roth (1806: 298); *Byssus cobaltigenus* Wulfen (in Jacquin Coll. 2: 175, pl. 12 f. 1, fide C. Agardh, loc. cit.); and *Byssus nigra* Hudson (1762: 487). The first four species are currently placed in *Trentepohlia*, either as synonyms or as autonomous species. The identity of the last two species is uncertain, but they probably are fungi. The inclusion of filamentous red algae with *Trentepohlia* and the establishment of *Chroolepus* to include several plants generically related to *Trentepohlia aurea* had the effect of reversing the circumscriptions of the two genera. This reversal was completed by Hooker (1833: 380), who removed *T. aurea* from *Trentepohlia* to *Chroolepus*. Harvey (in Mackay, 1836: 218, 219) added six species to *Trentepohlia* which formerly had been placed in *Callithamnion*. Four of these (*Callithamnion sparsum* Harvey in Hooker, 1833: 348; *C. Daviesii* (Dillwyn) Lyngbye, 1819: 129, pl. 41B, f. 1-3; *C. secundatum* (Lyngbye) C. Agardh, 1828: 187; and *C. lanuginosum* (Dillwyn) Lyngbye, 1819: 130, pl. 41C) are now placed in *Acrochaetium*, one (*C. floridulum* (Dillwyn) Lyngbye, 1819: 130, pl. 41D) is now placed in *Kylinia*, and one (*C. Rothii* Lyngbye, 1819: 129, pl. 41A) has been reduced to *Rhodochortum purpureum* (Lightf.) Rosenvinge (cf. Papenfuss, 1945 and 1947b). Thus the *Trentepohlia* of Harvey comprised marin as well as freshwater members of the *Acrochaetium-Rhodochortum* complex. Harvey placed it next to *Callithamnion* in the Rhodospermeae and, like Hooker, accredited the genus to C. Agardh. From this time (1836) until 1881, the name *Trentepohlia* was used by various authors to include either only the freshwater members of the *Acrochaetium-Rhodochortum* complex (Harvey, 1841: 118) or only the marine members of that complex (Areschoug, 1847: 115; Pringsheim, 1862: 29; Farlow, 1881: 108). Pringsheim re-established *Trentepohlia* under his own authorship. Drew (1928: 141-147) gives a detailed account of the history of the nomenclature of the *Acrochaetium-Rhodochortum* complex.

It was Thuret (in LeJolis, 1863: 105) who first pointed out that the change in circumscription of *Trentepohlia* was untenable and that the name *Trentepohlia* should be reserved for the genus based on *Byssus aurea* Linnaeus, as originally established by Martius. Many authors followed Thuret and took up *Trentepohlia* Martius over *Chroolepus* C. Agardh (Wille, 1878; Lagerheim, 1883: 73; Hansgirg, 1886: 85; DeToni, 1888: 449) while others continued to use *Chroole-*

pus (Rabenhorst, 1868: 371; Gobi, 1872; Kirchner, 1878: 75; Cooke, 1882-1884: 184; Wolle, 1887: 121). During the past 50 years all authors, to the knowledge of the writer, have adopted *Trentepohlia*.

Since *Trentepohlia* Martius is illegitimatized by the existence of two earlier homonyms, *Chroolepus* is available as a generic name. However, despite the changes in circumscription that this genus has undergone since its inception, resulting in taxonomic confusion, the fact that during the past 50 years *Trentepohlia* has universally stood for a clear-cut genus typified by *Byssus aurea* Linnaeus favors the conservation of *Trentepohlia* rather than the adoption of *Chroolepus*. Since the stabilization of the circumscription of *Trentepohlia*, many extensive studies have been made and numerous species have been added to the genus.

Mention should be made of the genus *Trentepohlia* which Böckeler (1858: 249) established in the Cyperaceae. This has subsequently been reduced to *Cyperus* Linnaeus (1753: 44).

CHAETOMORPHA Kützing (*Cladophoraceae*), Phyc. germ. 203. 1845.
versus

Spongopsis Kützing, Phyc. gen. 261. 1843.

Chloronitum Gaillon, Dict. sci. nat. 53: 389. 1828 (pro parte).

Type species: *Chaetomorpha melagonium* (Weber et Mohr) Kützing, Phyc. germ. 204. 1845. *Confervaria melagonium* Weber et Mohr, Reise nach Schweden: 194, pl. 3, f. 2. 1804.

Kützing (1843b) founded *Spongopsis* on his new species *S. mediterranea*, which he characterized as consisting of simple filaments arranged in an intricate spongy body. In 1847 (p. 177) he added a second species to the genus, *S. saccata*. In 1849 (p. 380) he reduced *Spongopsis* with its two species to a subgenus under *Chaetomorpha*. The latter genus had been founded by Kützing in 1845 to include those plants consisting of strictly unbranched filaments. He referred fifteen species to the genus at the time of publication. *Spongopsis mediterranea* has been identified with *Chaetomorpha tortuosa* Kützing (1849: 376) by Hauck (1883-1885: 440). Thus *Chaetomorpha* is illegitimatized by *Spongopsis*. Furthermore, *Chaetomorpha* is nomenclaturally synonymous with *Chloronitum* Gaillon (1828), which was established to encompass seven species formerly placed in *Confervaria*. Six of these species are referable to *Cladophora* Kützing (1843b: 262), which Papenfuss has proposed for conservation (1947a: 8). The remaining species, *Chloronitum aereum* (Dillwyn) Gaillon, is *Chaetomorpha aerea* (Dillwyn) Kützing (1849: 379).

Inasmuch as *Chaetomorpha* is a very large and widespread genus, while neither *Chloronitum* nor *Spongopsis* has received recognition, it seems highly desirable to propose *Chuetomorpha* for conservation.

CHRYSOPHYCOPHYTA.

HYDRURUS C. Agardh (*Hydruraceae*), Syst. alg. xviii, 24. 1824.

versus

Cluzella Bory, Dict. class. hist. nat. A: 14, 1823, Ibid. o: 234. 1823.

Type species: *Hydrurus foetidus* (Villars) Trevisan¹, Alg. coco. 75. 1848.

Bory founded *Cluzella* to receive *Batrachospermum Myosurus* Ducluzeau (1805: 76 = *B. myurus* Lamarek et De Candolle, 1805: 591). The following year C. Agardh established *Hydrurus* on two species: *Conferva foetida* Villars (1789: 1010, pl. 55), which he renamed *Hydrurus Vaucherii*; and *Batrachospermum Myosurus* Ducluzeau, which he renamed *H. penicillatus*. Although many species and varieties of *Hydrurus* have been described, the practice generally followed today (cf. G. M. Smith, 1933: 189; Fritsch, 1935: 546) is to recognize but one species, *H. foetidus* (Villars) Trevisan. Among the many synonyms of this species are *Cluzella Myosurus* (Ducluzeau) Bory (1823b: 234), *C. foetida* (Villars) Duby (1830: 963), *Hydrurus Vaucherii* C. Ag., *H. penicillatus* C. Ag., and *H. Myosurus* (Ducluzeau) Trevisan (1845: 57).

Hydrurus is widespread in its many forms and is well-known. To the writer's knowledge only Duby (1830: 962) and Kuntze (1893: ccxlv) have taken up *Cluzella* over *Hydrurus*. It would seem justifiable, therefore, to propose *Hydrurus* for conservation.

It is of interest to note that Trevisan, who faithfully abided by the law of priority in nomenclature, adopted *Hydrurus* rather than *Cluzella* (1848: 74). His reasons for doing so are somewhat obscure, but the implication is that *Cluzella* is unenable as a generic name because it violates grammatical rules. Bory intended it to honor Ducluzeau. Trevisan cites *Corradorus* S. F. Gray (1821: 350) as the earliest synonym of *Hydrurus*. He does not admit *Corradorus* as the proper generic name, however, because in honoring „G. Corradori” it should have been spelled *Corradoria*. Two discrepancies are involved here. First, the Italian scientist's name was Giovacchino Corradori, not Corradori. Second, Gray spelled his generic name *Carrodorus*, not *Corradorus*. The „correct” spelling of *Corradoria* was employed, according to Trevisan, by Martius (1833: 16) in proposing a genus which is now considered to be synonymous with *Polysiphonia* Greville (1824: lxvii, 308). Gray's single species of *Carrodorus* was based, as to name only, on *Conferva foetida* Villars. From Gray's description, from the fact that he gives „salt marshes and the seashore” as the habitat, and from his citation of *Conferva foetida* Dillwyn (1809: 70, pl. 104) and *C. foetida* J. E. Smith (in Engl. Bot., 1810, pl. 210) as synonyms, one may conclude that he was dealing not with *Hydrurus*, but with diatoms of the *Navicula* complex. Just which genus or genera *Carrodorus* S. F. Gray is synonymous with is yet to be determined. *Navicula* Bory (1822a: 128) and *Berkeleya* Greville (1827, pl. 294) are likely considerations. Kuntze (1891: 887) took up *Carrodorus* over *Hydrurus* and made the combinations *C.*

¹⁾ Kirchner (1878) has heretofore been accredited with first making this combination.

flagelliformis (Kütz.) Kuntze and *C. olivaceus* (Nägeli) Kuntze. Later Kuntze (1893: ccclv), following Rabenhorst, decided that *Carrodorus* was synonymous with *Schizonema* C. Agardh (1824: xv, 9) and therefore took up *Cluzella* over *Hydrurus*, making appropriate transfers. Finally Kuntze (1898: 399) „corrected“ the spelling of *Carrodorus* to *Carrodoria* and took up this generic name against *Berkeleya* Greville and *Amphibleura* Kützing (1844: 103), which two genera he considered synonymous. But even Kuntze's version of the name was not consistent with the spelling of *Carradori*. Trevisan (1849: 131) commemorated his compatriot by proposing the name *Corradoria* for a genus segregated from *Caulerpa* Lamouroux (1809: 141); here again it is incorrectly spelled. Only *Carrodoria* A. De Candolle (1848: 610 = *Globularia* Linnaeus, 1753: 95) in the *Globulariaceae* is orthographically correct.

PHAEOPHYCOPHYTA.

SOROCARPUS Pringsheim (Ectocarpaceae), Beitr. Meeres-Alg. 12. 1862.
versus

Botrytella Bory, Dict. class. hist. nat. 2: 425. 1822.

Type species: *Sorocarpus micromorus* (Bory) Silva comb. nov.
Botrytella micromora Bory, loc. cit.

Sorocarpus was established by Pringsheim to receive *Ectocarpus siliculosus beta uvaeformis* Lyngbye (1819: 132, pl. 43D). Lyngbye's plant had already been made the basis of a new genus, however, by Bory, who founded *Botrytella* in 1822. In elevating Lyngbye's variety to specific rank, Bory changed the specific epithet to *micromora*. Inasmuch as *Botrytella* was not adopted by other workers and since *Sorocarpus* has been rather widely studied (Kjellman, 1891; Abe, 1935; Takamatsu, 1936) and has been expanded to include several species (Takamatsu, 1936), it seems desirable to conserve the generic name *Sorocarpus*. In doing so, however, a new combination would be in order for the type species: ***Sorocarpus micromorus* (Bory) Silva** comb. nov. In addition, three forms of *S. uvaeformis*, proposed by Takamatsu (1936: 90, 92; pl. 4, 5) and Reinke (1889: 44) would require new combinations: ***Sorocarpus micromorus forma typicus* (Takamatsu) Silva** comb. nov., ***Sorocarpus micromorus forma japonicus* (Takamatsu) Silva** comb. nov., and ***Sorocarpus micromorus forma balsicus* (Reinke) Silva** comb. nov.

SAUVAGEAUGLOIA Hamel ex Kylin (Chordariaceae), Chordariales 32. 1940.

Sauvageaugloia Hamel, Bot. Not. 1939: 70. 1939 (nom. nud.). Phéophyc. de France xxxviii. 1939 (nom. nud.).

versus

Trichocladia Harvey in Mackay, Fl. hibern. 183. 1836.

Type species: *Sauvageaugloia Griffithiana* (Greville in Hooker) Hamel ex Kylin, loc. cit.

The various gelatinous cylindrical algae were a source of much

taxonomic confusion in the first half of the nineteenth century. As their structure and reproduction became known in greater detail, the members of the complex were segregated into genera in accordance with current concepts. Although C. Agardh founded *Mesogloia* (1817: xxxvii) on a single species, *M. vermicularis*, he soon (1824: 50-52) expanded the genus to include eight of these gelatinous cylindrical algae characterized by a filamentous axis bearing lateral assimilating filaments. These were arranged in two series as follows:

- a. Rubrae („an proprium genus?”)
 1. *M. multifida* (*Rivularia multifida* Weber et Mohr, 1804: 193, pl. 3, f. 1)
 2. *M. Hudsoni*
 3. *M. coccinea* (*Ulva coccinea* Poiret, 1808: 165. *Ulva verticillata* Withering?, 1796: 127. *Rivularia verticillata* J. E. Smith in Eng. Bot., pl. 2466. 1813.)
 4. *M. fruticulosa*
 5. *M. ? capillaris* (*Fucus capillaris* Hudson, 1778: 591) „An distincti generis?”
 6. *M. divaricata*
 7. *M. attenuata*
 - b. Fuscescentes.
 8. *M. vermicularis* (*Alcyonidium vermiculatum* Lamouroux, 1813: 286)
beta *coriaceum* (*Rivularia vermiculata* J. E. Smith in Eng. Bot., pl. 1818. 1808. Per error. pl. 1819)

At the same time, C. Agardh expressed the idea that *Mesogloia* perhaps should be divided into two genera in consideration of the diverse coloration of its members (p. xxiii).

Carmichael (in Berkeley, 1833: 45) was the first to place one of these eight species in its own genus. He proposed *Gloiosiphonia* to receive *Fucus capillaris* Hudson. At the same time Berkeley (pp. 43, 44) added three species to *Mesogloia*, two from Carmichael's manuscript and one of his own. These three species — *M. affinis* Berkeley, *M. gracilis* Carmichael, and *M. virescens* Carmichael — have all been reduced to the last-named species, which De Toni (1891: 178) indicated as the type species of *Eudesme* J. Agardh (1880-81: 31). Later in the same year, Hooker (1833: 386, 387) published two more species of *Mesogloia*: *M. Griffithsiana* Greville mrs. in the section „olive-green”; and *M. purpurea* Harvey ms. in the section „purple or rose-red.” *M. Griffithsiana* has become the type species of *Sauvageaugloia* Hamel ex Kylin (1940: 32) while *M. purpurea* was named by Schmitz (1889: 438) as the type species of *Helminthocladia* J. Agardh (1852: 412). *Helminthocladia purpurea* (Harvey in Hooker) J. Ag. is now known as *H. calvadosii* (Lamouroux ex Turpin²) Setchell (in Collins, Holden and Setchell, 1915, no. 2035).

At the beginning of 1835, then, *Mesogloia* was generally consider-

²) *Dumontia Calvadosii* Lamouroux ex Turpin, 1816-1829, pl. Bot. Acotyl. Alg.

ed to contain seven of the eight species listed by C. Agardh (1824) plus the additions of Carmichael, Berkeley, Greville, and Harvey. The Crouan brothers (1835: 98) were the first to object to the inclusiveness of *Mesogloia*. Their conclusions, however, vary widely from modern concepts. They named *Rivularia multifida* Weber et Mohr as the type species of *Mesogloia* and considered both *M. Hudsoni* and *M. capillaris* as belonging to *Dumontia* Lamouroux (1813: 133). Finally, they reestablished *Dudresnaya* Bonnemaison (1822: 180) to receive *M. coccinea*, which they felt was quite unlike *M. multifida*. In the same year (presumably later than the Crouans), Fries, (1835: 311) placed *Rivularia multifida* Weber et Mohr in his genus *Helminthora*, which he had established in 1825 (p. 341) but to which he had heretofore referred no species. Since *Rivularia multifida* is now recognized as a species of *Nemalion* Duby (1830: 959), it follows that *Nemalion* is illegitimatized by *Helminthora* Fries (1825).

Fries (1835: 312) intended his *Helminthora* to include the section *Rubrae* of *Mesogloia*. Harvey (in Mackay, 1836), apparently unaware of Fries's work, independently established separate genera for C. Agardh's two sections of *Mesogloia*. Unfortunately, he retained the name *Mesogloia* for the section *Rubrae*, thus excluding the type species, *M. vermicularis*. The latter species, constituting the section *Fuscescentes* of C. Agardh, together with *M. Griffithsiana* and *M. virescens*, was placed in a new genus which Harvey named *Trichocladia* (p. 183). Because he felt that *Trichocladia* „too nearly approaches n sound and sense the more ancient *Trichocladus* [Persoon, 1807: 597. Hamamelidaceae]”, Harvey changed the name of his genus to *Helminthocladia* (1838: 396). *Trichocladia*, however, is sufficiently distinct from *Trichocladus*, both in orthography and in taxonomic position, to preclude confusion (cf. Article 70 of the International Rules of Botanical Nomenclature), and must be regarded as a legitimate name. Of the original three species in *Trichocladia*, *T. vermicularis* was already the type species of *Mesogloia* C. Agardh (1817) and *T. virescens* was to become the type species of *Eudesme* J. Agardh (1880-81). The last species to remain in the genus, then, was *T. Griffithsiana*, which was recently made the type species of *Sauvageaugloia* Hamel ex Kylin (1940). Therefore, *Sauvageaugloia* is illegitimatized by *Trichocladia*. It is apparent from Harvey's description and from the fact that the type species of *Mesogloia* C. Agardh was excluded from Harvey's concept of *Mesogloia* but included in *Trichocladia*, that *Trichocladia* taxonomically was intended to be synonymous with *Mesogloia* C. Agardh. Therefore, despite the recentness of Hamel's genus and the fact that it includes but two species, it seems advantageous to conserve it against *Trichocladia*. *Sauvageaugloia* comprises *S. Griffithsiana* (Greville in Hooker) Hamel ex Kylin, the type species, and *S. chordariaeformis* (Crouan frat.) Kylin (1940: 33).

Mesogloia was restored to its original circumscription by J. Agardh (1841: 452), who pointed out that *M. vermicularis* was the true type of the genus and that *M. multifida* was really a species of *Nemalion*. Like the Crouan brothers, however, he considered *M. Hudsoni* and *M. capillaris* as belonging to *Dumontia*.

In 1842 J. Agardh made *M. attenuata* the type species of his *Crouania* (p. 83). This was the fourth member of C. Agardh's *Mesogloia* of 1824 to be removed to its own genus. At the same time, J. Agardh reaffirmed the purification of *Mesogloia* (p. 33), to which he added a new species: *M. mediterranea*. In 1843, Meneghini published the result of a rather extensive study of the Chordariaceae, in which *Mesogloia* was retained in its original sense. Kützing retained the original concept of *Mesogloia* (1843b: 332), but placed the red members of the genus in *Helminthora* Fries (p. 391), thus following Fries. In 1849 Kützing maintained the same position, but took up *Nemalion* Duby (1830) over *Helminthora* Fries (1825). It was J. Agardh (1848, 1851, 1852) who first arranged all of C. Agardh's eight species of *Mesogloia* in accordance with current concepts. He adopted *Mesogloia* C. Agardh, 1817 (*M. vermicularis*) ; *Nemalion* Duby, 1830 (*M. multifida*) ; *Gloiosiphonia* Carmichael in Berkeley, 1833 (*M. capillaris*) ; *Dudresnaya* Crouan frat., 1835 (*M. coccinea*) ; and *Crouania* J. Agardh, 1842 (*M. attenuata*). In addition he made *Mesogloia divaricata* C. Agardh the type species of his new genus *Helminthora* (1852: 415) and based another new genus, *Helminthocladia* (1852: 412), on *Mesogloia Hudsoni* C. Agardh and *M. purpurea* Harvey in Hooker. *Helminthora* J. Agardh (1852) has been proposed for conservation over *Helminthora* Fries (1825) by Papenfuss (1947a: 11). If this proposal is accepted, there will be no need to conserve *Nemalion* Duby (1830), which is illegitimatized by *Helminthora* Fries. *Helminthocladia* J. Agardh (1852) has been proposed for conservation over *Helminthocladia* Harvey (1838) by Tandy (cf. Sprague, 1935: 67). The last of C. Agardh's eight species to be disposed of is *M. fruticulosa*, which J. Agardh (1852: 109) reduced to *Dudresnaya coccinea*.

From the foregoing account it can be seen that within twenty years (1824 to 1841) the genus *Mesogloia* was returned from its maximal circumscription as of C. Agardh (1824) and others, including both brown and red gelatinous cylindrical algae, to its minimal circumscription as originally established, including only brown algae. By 1852 all the red algae formerly placed in *Mesogloia* had been assigned to new genera in accordance with current concepts. Subsequent to J. Agardh's purification of *Mesogloia* in 1841, several other species have been added to the genus which later were made the type species of new genera. These include *M. natalensis* Kützing (1847: 53), which has become the type species of *Levingia* Kylin (1940: 15) ; *M. crassa* Suringar (1872: 85, pl. 10-12), the type species of *Tinocladia* Kylin (1940: 33) ; *M. Andersonii* Farlow (1889: 9, pl.

87, f. 2), the type species of *Haplogloia* Levring (1939: 48); and *M. simplex* Saunders (1901: 423, *pl. 50, f. 2-4*), the type species of *Saundersella* Kylin (1940: 41). In addition, two other species have been placed in *Mesogloia* which Kylin (1940: 7) retains in that genus: *M. lanosa* Crouan frat. (1867: 166, *pl. 26, f. 166*); and *M. reticulata* Kuckuck (1929: 56).

By way of summary, the various species which have been placed in *Mesogloia* are listed below with their disposition in accordance with Kylin (1940) for the brown algae and well-established modern concepts for the red algae.

- M. affinis* Berkeley (1833: 43, *pl. 16, f. 2*) = *Eudesme virescens* (Carmichael in Berkeley) J. Agardh (1880-81: 31).
- M. Andersonii* Farlow (1889: 9, *pl. 87, f. 2*) = *Haplogloia Andersonii* (Farl.) Levring (1939: 50). Type species.
- M. attenuata* C. Agardh (1824: 51) = *Crouania attenuata* (C. Ag.) J. Agardh (1842: 83). Type species.
- M. baltica* Areschoug (1864, no. 216) = *Eudesme virescens*.
- M. Bertolonii* Moris et DeNotaris (1839: 271, *pl. 4, f. 3*) = *Nemalion helminthoides* (Vellay in Withering) Batters (1902: 59).
- M. capillaris* (Hudson) C. Agardh (1824: 51) = *Gloiosiphonia capillaris* (Huds.) Carmichael in Berkeley (1833: 45). Type species.
- M. coccinea* C. Agardh (1824: 51) = *Dudresnaya verticillata* (Withering) LeJolis (1863: 117). Type species.
- M. crassa* Suringar (1872: 85, *pl. 10-12*) = *Tinocladia crassa* (Suringar) Kylin (1940: 34). Type species.
- M. decipiens* Suringar (1872: 75, *pl. 4*) = *Nemacystus decipiens* (Suringar) Kuckuck (1929: 68).
- M. divaricata* C. Agardh (1824: 51) = *Helminthora divaricata* (C. Ag.) J. Agardh (1852: 416). Type species.
- M. divaricata* (C. Ag.) Kützing (1843b: 332) = *Chordaria divaricata* C. Agardh (1817: 12) = *Sphaerotrichia divaricata* (C. Ag.) Kylin (1940: 38). Type species.
- M. Ekmani* Areschoug (1864, no. 215) = *Myriocladia Ekmani* (Areschoug) Kylin (1907: 90).
- M. falklandica* Skottsberg (1921: 25) = *Tinocladia falklandica* (Skottsberg) Kylin (1940: 36).
- M. filum* Harvey (1855: 536) = *Cladosiphon filum* (Harvey) Kylin (1940: 29).
- M. fistulosa* Zanardini in Meneghini (1842: 292) = *Cladosiphon mediterraneus* Kützing (1843b: 329, *pl. 25, f. I*).
- M. flavescens* Zanardini (1858: 251, *pl. 4, f. 2*) = *Eudesme? flavescens* (Zan.) DeToni (1895: 404). Fide DeToni, loc. cit.
- M. fruticulosa* C. Agardh (1824: 51) = *Dudresnaya verticillata*.

- M. gracilis* Carmichael in Berkeley (1833: 43) = *Eudesme virescens*.
M. Griffithsiana Greville in Hooker (1833: 387) = *Sauvageaugloia Griffithsiana* (Greville in Hooker) Hamel ex Kylin (1940: 33).
 Type species.
M. Hornemannii Suhr ex Kützing (1843: 332) = *Eudesme virescens*.
M. Hudsonii C. Agardh (1824: 50) = *Helminthocladia Hudsonii* (C. Ag.) J. Agardh (1852: 413).
M. lanosa Crouan frat. (1867: 166, pl. 26, f. 166).
M. Leveillei (J. Agardh) Meneghini (1843: 283, pl. 5, f. 2) = *Leibmannia Leveillei* J. Agardh (1842: 35). Type species.
M. linearis Hooker f. et Harvey (1845: 251) = *Chordaria linearis* (H. f. & H.) Cotton (1915: 169).
M. Lovenii (J. Agardh) Kützing (1858: 3, pl. 5, f. II) = *Myriocladia Lovenii* J. Agardh (1841: 481). Type species.
M. mediterranea J. Agardh (1842: 33) = *Cladosiphon mediterraneus*.
M. microcarpa Montagne (1844c: 660) = *Sebdenia ceylanica* (Harvey) Heydrich (1892: 477). Fide DeToni (1895: 429).
M. ? moniliformis Griffiths in Harvey (1839: 49) = *Crouania attenuata*.
M. multifida (Weber et Mohr) C. Agardh (1824: 50) = *Nemalion multifidum* (Weber et Mohr) J. Agardh (1841: 453).
M. natalensis Kützing (1847: 53) = *Levrinia natalensis* (Kütz.) Kylin (1940: 15). Type species.
M. Posedoniae (J. Agardh) Kützing (1949: 545) = *Cladosiphon mediterraneus*.
M. purpurea Harvey in Hooker (1833: 386) = *Helminthocladia calvadosii* (Lamouroux ex Turpin) Setchell (in Collins, Holden and Setchell, 1915, no. 2035). Type species.
M. reticulata Kuckuck (1929: 56).
M. simplex Saunders (1901: 423, pl. 50, f. 2-4) = *Saundersella simplex* (Saunders) Kylin (1940: 42). Type species.
M. vermicularis C. Agardh (1817: 126) = *Mesogloia vermiculata* (J. E. Smith) Gray³ (1821: 320). Type species.
M. vermiculata (J. E. Smith) Gray (1821: 320). Type species.
M. virescens Carmichael in Berkeley (1833: 44, pl. 17, f. 2) = *Eudesme virescens* (Carmichael in Berkeley) J. Agardh (1880-81: 31). Type species.
M. zosterae (J. Agardh) Areschoug (1842: 228, pl. 8, f. 1, 1b) = *Cladosiphon zosterae* (J. Agardh) Kylin (1940: 28).
 Species inquirendae.
M. brasiliensis Montagne (1843: 304).
M. implicata Suhr (1834a: 209).

³⁾ Le Jolis (1863) has heretofore been accredited with first making this combination.

M. intestinalis Harvey in Hooker f. (1855: 220).

M. neglecta Batters (1906: 2, pl. 475, f. 7).

M. ramosissima Zanardini (1858: 250, pl. 4, f. 1).

CYSTOPHYLLUM J. Agardh (Cystoseiraceae), Sp. alg. I: 228. 1848.

versus

Sirophysalis Kützing, Phyc. gen. 368. 1843.

Myagropsis Kützing, Bot. Zeit. I: 57, 1843: Phyc. gen. 368. 1843.

Spongocarpus Kützing, Bot. Zeit. I: 55, 1843; Phyc. gen. 365. 1843
(pro parte).

Type species: *Cystophyllum trinode* (Forskål) J. Agardh, Sp. alg. I: 230. 1848 (cf. De Toni, 1891: 175).

In 1843 Kützing added several new genera to the Sargassaceae. Among these were *Sirophysalis*, based on *Fucus muricatus* Turner (1809: 107, pl. 112); and *Myagropsis*, based on *Fucus myagroides* Turner (1809: 28, pl. 83) and on *M. Camelina* Kützing, a new species from the Japan Sea. Later, J. Agardh (1848) established the genus *Cystophyllum*, based on nine species which formerly had been placed in *Cystoseira* C. Agardh (1820), *Sargassum* C. Agardh (1820), *Sirophysalis* Kützing, *Myagropsis* Kützing, and *Spongocarpus* Kützing. The latter genus was established on three species, two of which are now referred to *Sargassum*, the third to *Cystophyllum*. Thus *Sirophysalis* was completely absorbed by J. Agardh's genus, as was *Myagropsis*, whose two species were reduced to *Cystophyllum sisymbrioides* (C. Ag.) J. Agardh (1848: 234). When *Cystophyllum* was formulated, one of the names of the constituent genera should have been retained. Inasmuch as *Cystophyllum* has become a rather large and well-known genus, however, it seems advantageous to conserve this name.

Mention should be made of the subgenus *Cystophyllum* proposed by Endlicher (1843: 31) to include *Cystoseira phyllocephala* C. Agardh (1820: 79). This species was transferred to *Coccophora* Greville (1830) by J. Agardh (in C. Agardh, 1846: [1], pl. 4). Yendo (1907: 49, pl. 5) has shown it to be but a sterile form of *Coccophora Langsdorffii* (Turner) Greville (1830: xxxiv).

RHODOPHYCOPHYTA.

DUDRESNAYA Crouan frat. (Dumontiaceae), Ann. Sci. Nat. Bot. II, 3: 98, pl. 2, f. 2, 3. 1835. Non *Dudresnaya* Bonnemaison, Jour. Phys. 94: 180. 1822.

versus

Borrichius S. F. Gray, Nat. arr. Brit. plants I: 330. 1821.

Type species: *Dudresnaya verticillata* (Withering) Le Jolis, Liste alg. mar. Cherbourg 117. 1863. *Ulva verticillata* Withering, Arr. Brit. plants, ed. 3, 4: 127. 1796. *Rivularia verticillata* J. E. Smith, Eng. Bot., pl. 2466. 1813. *Dudresnaya coccinea* (C. Ag.) Crouan frat., loc. cit.; Alg. mar. Finist., no. 163. 1852.

In 1821 S. F. Gray founded the genus *Borrichius* on Withering's *Ulva verticillata*, which he took into the genus as *Borrichius gelatinosus*. From Gray's description and citation of synonyms there can be but little doubt that he was dealing with the plant which is now known as *Dudresnaya verticilata* (Withering) LeJolis. *Dudresnaya*, however, was not described until the following year (1822). Moreover, as originally circumscribed by Bonnemaison, it is synonymous with *Mesogloia* C. Agardh (1817: xxxvii, 126). In the text, Bonnemaison (p. 181) mentions *Fucus capillaris* Hudson (1778: 591) as being in the genus. This species later became the type of Carmichael's *Gloiosiphonia* (in Berkeley, 1833: 45, pl. 17, f. 3). At the end of the next to last paragraph of the text of *Dudresnaya* (the last paragraph being a dedication of the genus to Colonel Dudresnay de Saint-Pol-de-Léon), Bonnemaison implies *Alcyonium vermiculatum* Lamouroux (1813: 286) as the principal species of the genus. The essential synonymy of *Alcyonium vermiculatum* Lamouroux is as follows:
Rivularia vermiculata J. E. Smith, Eng. Bot., pl. 1818. 1808.
Mesogloia vermicularis C. Agardh, Syn. alg. scand. 126. 1817.
Mesogloia vermiculata (J. E. Smith) S. F. Gray, Nat. arr. Brit. plants 1: 320. 1821.

Batrachosperma alcyonidea Bory, Dict. class. hist. nat. 2: 227. 1822.
Trichocladia vermicularis (C. Agardh) Harvey in Mackay, Fl. hibern 2: 184. 1836.
Helminthocladia vermicularis (C. Agardh) Harvey, Gen. South Afr. plants 397. 1838 (as to name only).

The genus *Mesogloia* was founded by C. Agardh on the single species *M. vermicularis*. Since the type of *Dudresnaya* Bonnemaison (1822) is conspecific with the type of *Mesogloia* C. Agardh (1817), as indicated by the foregoing synonymy, it follows that *Dudresnaya* cannot be retained in its original circumscription. The present concept of the genus, however, dates from the reestablishment of *Dudresnaya* by the Crouan brothers in 1835 to receive *Mesogloia coccinea* C. Agardh (1824: 51 = *Rivularia verticillata* J. E. Smith, 1813, pl. 2466; *Ulva verticillata* Withering, 1796: 127). Their combination of *Dudresnaya coccinea* (C. Ag.) Crouan frat. has been properly re-applied by *D. verticillata* (Withering) LeJolis. Within the circumscription of the Crouan brothers, Schmitz (1889: 453) named *D. coccinea* as the type species of the genus.

In order to maintain the generic concepts and nomenclature currently in use and firmly established, it seems advantageous to conserve *Dudresnaya* Crouan frat. (1835) rather than take up Gray's *Borrichius*, which was not adopted by any other author. The great historical importance of *Dudresnaya* lends support to the proposal for conservation. Bornet and Thuret (1867), who first established the existence of sexual reproduction in the Florideae, worked out the details of the development of the cystocarp in two species of *Dudresnaya*: *D. verticillata*; and *D. purpurifera* J. Agardh, which

Sjöstedt (1926) has made the type of a new genus *Acrosymphyton*. It should be noted, also, that J. Agardh, when describing *Dudresnaya purpurifera* (1842 : 85), cited the authorship of *Dudresnaya* as „Crouan Ann. des Sc. Nat. (reform. char.)”.

The etymology of the generic name *Dumontia* (and thereby of the family name *Dumontiaceae*) has frequently been misquoted by recent authors. When Lamouroux established the genus *Dumontia* (1813 : 133), he dedicated it to his „respectable ami M. Ch. Dumont, l'un des auteurs du Dictionnaire d'histoire naturelle.” The dedication was repeated by Lamouroux in the article entitled „Dumontie” in the *Dictionnaire classique d'histoire naturelle* 5: 642, 1824, and subsequently was cited correctly by Greville (1830: 164). Wittstein (1852: 306), however, stated that *Dumontia* was named for G. Dumont de Courset. This etymology was adopted by Pritzel (1872: 94) and by Newton (1931: 274). In the meantime De Toni (1905: 1621) introduced another version, stating that the genus was named for „Dumont d'Urville, navigatore celeberrimo.” A listing of the three Dumonts with the genera named for them will clarify the situation:

Charles Henri Frédéric Dumont de Sainte-Croix (1758-1830), author of the articles on birds in „*Dictionnaire des Sciences naturelles, etc.*” This dictionary, edited by George Frédéric Cuvier, was published at Strasbourg and at Paris in sixty volumes from 1816 to 1830. The first five volumes had been printed earlier (1804-06), at which time publication was suspended until 1816, when these five volumes were reprinted with supplements. *Dumontia* was named for this ornithologist.

Baron Gerorge Louis Marie Dumont de Courset (1746-1824), who established a botanical garden at Courset near Boulogne sur Mer and was author of „*Le botaniste cultivateur.*” *Coursetia*, a DeCanolleean genus in the Leguminosae, commemorates this botanist.

Jules Sébastien César Dumont d'Urville (1790-1842), seafarer, who was second in command of the voyage of *La Coquille* (1822-1825) and commander of two expeditions: the voyage of *l'Astrolabe* (1826-1829); and the voyage of *l'Astrolabe* and *la Zélée* (1837-1840). *Urvillea* Humboldt, Bonpland et Kunth in the Sapindaceae and *Durvillaea* Bory in the Durvillaeaceae both commemorate this navigator-botanist.

ARESCHOUGLIA Harvey (Rhabdoniaceae), Trans. Roy. Irish Acad. 22: 554. 1855.

versus

Areschougia Meneghini, Giorn. Bot. Ital. 1: 293. 1844.

Areschougia Trevisan, Nomen. alg. 43. 1845.

Type species: *Areschougia Laurencia* (Hooker f. et Harvey) Harvey, loc. cit.

A nomenclatural imbroglio exists, involving primarily the generic names *Lenormandia* and *Areschougia*, which deserves attention. In

1821 Humbolt, Bonpland, and Kunth established the genus *Urvillea*, naming it after Jules Dumont d'Urville (Nov. gen. 5: 105). This genus is still recognized and is placed in the Sapindaceae. In 1826 Dumont d'Urville was again honored, this time by Bory, who founded the genus *Durvillaea* (p. 192). *Durvillaea* is now the type genus of the family Durvillaeaceae in the order Fucales of brown algae. Trevisan (1843: 332), taking the position that *Durvillaea* was but an orthographical variant of *Urvillea*, proposed to substitute the name *Lenormandia* for *Durvillaea*. This action is complicated by the fact that Delise had already used the name *Lenormandia* for a genus of lichens (in Desmazières, Pl. crypt. France, ed. 1, no. 1144, 1841), based on *L. Jungermanniae*.

It is necessary to digress for a moment in order to introduce another genus which is an integral part of the tangle. In 1841 J. Agardh (p. 22) established the genus *Mammea*, based on two previously described species: *Delesseria fimbriata* Lamouroux (1813: 124, pl. 9, f. 1); and *Rhodomela dorsifera* C. Agardh (1822: 372). But Linnaeus had long before founded a genus *Mammea* (1737: 344; 1753: 512), which is now placed in the Guttiferae. Trevisan quickly observed this discrepancy and in a manuscript entitled „Synopsis generum Algarum, adjecta enumeratione specierum hucusque cognitarum cum synonymis omnibus”, proposed to substitute the name *Callophycus* for *Mammea* J. Agardh. The manuscript was dated 1842, but apparently it was never published in its entirety. An abstract appeared in the proceedings of the fourth congress of Italian scientists, dated August 15, 1843. In the abstract, however, the name *Callophycus* do not appear. The combination *Callophycus dorsiferus* appears in Trevisan's „Nomenclator Algarum” (1845: 67), but merely as a synonym of *Bonnemaisonia dorsifera* Endlicher. *Callophycus* may thus be considered to be validly published only in Trevisan's „Alge Coccotalle” (1848: 107), where, in a footnote, he discusses the illegitimacy of *Mammea* J. Agardh. Endlicher (1843: 44) also noted the homonymy and, apparently unaware of Trevisan's intentions, substituted the name *Thysanocladia* for *Mammea* J. Agardh. The dedication of the third supplement of Endlicher's work is dated October 4, 1843. Still a third person to object to J. Agardh's *Mammea* was Montagne, who not only rejected the name, but divided the genus into two parts. Lamouroux's genus *Delisea* (1824a: 389) was taken up to include *Mammea fimbriata* (Lamouroux) J. Ag. in addition to two other species; and a new name — *Lenormandia* — was substituted for *Mammea*, the type of this emended genus being *Mammea dorsifera* (C. Ag.) J. Ag. Montagne's ideas were presented in a memoir entitled „Quelques observations touchant la structure et la fructification des genres *Ctenodus*, *Delisea* et *Lenormandia*, de la famille des Floridées”, which first appeared in abstract form in the Compte Rendu des séances de l'Académie des Sciences, Séance du mardi 26 décembre 1843 (pp. 1357-59). The complete memoir ap-

peared in the *Annales des Sciences Naturelles, Botanique*, iii, 1: 151-161, 1844.

A second digression is necessary in order to introduce further considerations. In 1844 Meneghini divided Duby's *Elachista* (1830: 972, as *Elachistea*) into two genera, segregating *E. stellaris* Areschoug (1842: 233), *E. curta* Areschoug (1842: 234), and *E. breviarticulata* (Suhr) Areschoug (*loc. cit.*) under the generic name *Areschougia* (p. 293). In this respect he was following Areschoug (1832: 231-236), who distributed the species of *Elachista* between two unnamed sections, the first section comprising *E. stellaris*, *E. curta*, and *E. breviarticulata*, the second section comprising *E. fucicola* (Velley) Areschoug (1842: 235), *E. Rivulariae* Suhr ex Areschoug (*loc. cit.*), and *E. velutina* (Greville) Fries⁴ (1835: 317). For reasons which are not apparent, Trevisan (1845: 42) substituted the name *Centrospora* for Meneghini's *Areschougia*. Later (1848: 103) he credits *Centrospora* to Areschoug, but nowhere in Areschoug's published works has this name been found. Zanardini (1846: 900) also credited *Centrospora* to Areschoug and adopted it in preference to *Areschougia* Meneghini.

In the meantime Sonder had established a genus based on an Australian red alga collected by Preiss, selecting the unfortunate generic name of *Lenormandia* (1845: 54). The type species is *Lenormandia spectabilis* Sonder. Trevisan once again participated, and at the same time that he substituted *Centrospora* for Meneghini's *Areschougia*, substituted his own *Areschougia* for Sonder's *Lenormandia* (1845: 43).

The climax was reached when Harvey (1855: 554) established the genus *Areschougia* to contain two Australian species of red algae. This genus is now placed in the Rhabdoniaceae.

The complications of this nomenclatural tangle may be made more readily understandable by tabulating the synonyms, as follows:

1. *Durvillaea* Bory 1826 (non *Urvillea* H. B. K. 1821)
Lenormandia (2) Trevisan 1843 (non *Lenormandia* (1) Delise 1841)
2. *Thysanocladia* Endlicher 1843
Mammea J. Agardh 1841 (non *Mammea* Linnaeus 1753)
Lenormandia (3) Montagne 1844 (non *aliorum*)
Callophycus Trevisan 1848
3. *Areschougia* (1) Meneghini 1844
Centrospora Trevisan 1845
Symporicoccus Reinke 1888
4. *Lenormandia* (4) Sonder 1845 (non *aliorum*)
Areschougia (2) Trevisan 1845 (non *Areschougia* (1) Meneghini 1844)

⁴ Areschoug (1842) has heretofore been accredited with first making this combination.

5. *Areschougia* (3) Harvey 1855 (non aliorum)

Each of the five genera may be considered in turn. In the International Rules of Botanical Nomenclature, among the examples given under Article 70, dealing with the orthography of names, *Urvillea* and *Durvillea* are listed as examples of different names. Bory's genus is therefore quite validly named. *Thysanocladia* Endlicher is apparently the legitimate name for the genus based on *Rhodomela dorsifera* C. Ag. Similarly *Areschougia* Meneghini is apparently the legitimate name for the genus of Elachistaceae as segregated from *Elachista* proper. Sonder's *Lenormandia* and Harvey's *Areschougia* are both without legal support. The first question is the advisability of retaining *Areschougia* Meneghini. Seemingly Meneghini's name was not adopted until very recently when Kylin (1947: 49) revived it for the species that previously had been going under the name *Syphoricoccus stellaris* (Areschoug) Kuckuck (in Skottsberg, 1921: 24). Workers in the intervening century had either accepted *Centrospora* [Areschoug] Trevisan or retained the species of *Areschougia* in *Elachista*. During the same period, however, Harvey's *Areschougia* became a well-known genus and was expanded to include at least five species. It has no available synonyms. To retain *Areschougia* Meneghini for the elachistaceous genus and propose a new name for Harvey's genus would create unnecessary confusion. Since the revival of Meneghini's genus is so recent, it seems logical to retain the generic name that has been in use and which is a valid synonym, namely, *Syphoricoccus* Reinke (1888: 17). This genus was established on the basis of *S. radians* Reinke, which Kuckuck later found to be identical with *Elachista stellaris* Areschoug and hence reduced to synonymy under *Syphoricoccus stellaris* (Areschoug) Kuckuck (in Skottsberg, 1921: 24; Kuckuck, 1929: 34). In this connection it is suggested that *Elachista stellaris* Areschoug may be identical with *Rivularia stellata* Suhr (1834a: 210, pl. 3, f. 5). We may return to *Syphoricoccus* Reinke without conserving it against *Areschougia* Meneghini by conserving *Areschougia* Harvey. This action would greatly stabilize the nomenclature in general use today. *Syphoricoccus* Reinke would not have to be conserved against *Centrospora* [Areschoug] Trevisan, since the latter name was an illegitimate substitution for *Areschougia* Meneghini.

There remains to be considered the disposition of Sonder's *Lenormandia*. Montagne identified *Lenormandia Jungermanniae* Delise first (1841: 123) with *Coccocarpia molybdaea* Persoon (in Gaudichaud, 1826: 206), but later (1849: 347) with *Verrucaria pulchella* Borrer (in Sowerby, 1831, pl. 2602, f. 1). Trevisan's *Lenormandia* at no time was taken up against Bory's *Durvillaea*. Montagne's *Lenormandia* apparently was not taken up by anyone other than its author, *Thysanocladia* Endlicher being in general use for the past century. Sonder's *Lenormandia*, on the other hand, has been expanded from

the original *L. spectabilis* to include nine species and has become well-known. In the interests of nomenclatural stability, therefore, it is suggested that *Lenormandia* Sonder be considered for conservation.

The choice of the type species of *Areschougia* Harvey has been governed by the following considerations. Harvey (1855: 554) founded the genus on two specimens from Rottnest Island, Western Australia. He regarded the first specimen (no. 173) as identical with *Halymenia australis* (Sonder) Sonder (1847: 173) and hence made the combination *Areschougia australis* (Sonder) Harvey. Similarly, he regarded the second specimen (no. 236) as identical with *Thamnacarpus?* *Laurencia* Hooker f. et Harvey (1847: 409) and made the combination *Areschougia Laurencia* (H. f. & H.) Harvey. Harvey supplied a generic diagnosis but no specific diagnoses; therefore, the two species were differentiated only by the citation of synonyms. In 1858 Harvey (*pl. 13*) named *Areschougia australis* as the type species of the genus and supplied it with a diagnosis. In 1872 J. Agardh (p. 26) expressed the opinion that Harvey's *A. australis* was a different species from *Halymenia australis* Sonder. Accordingly, he redescribed Harvey's plant under the name *Areschougia ligulata* (Harv. msr.) J. Agardh (*A. ligulata* being a manuscript name of Harvey's in the Herbarium of Trinity College, Dublin), citing as synonyms *A. australis* Harvey (1855: 554; 1858, *pl. 13*, exclus. synon.), and assigned *Halymenia australis* (Sonder) Sonder with a query to *Stenocladia conferta* alpha *Cliftoni* (*op. cit.*: 45). Since the two species upon which *Areschougia* was based were not separately diagnosed, but were differentiated only by the citation of synonyms, the binomial *Areschougia australis* (Sonder) Harvey, having been applied erroneously to *Halymenia australis* (Sonder) Sonder, must be regarded as a synonym of the latter species (cf. Article 54 of the International Rules of Botanical Nomenclature). Consequently *Areschougia australis* Harvey (1858, *pl. 13*, exclus. syn.) is a later homonym, and the legitimate name for Harvey's species is *A. ligulata* Harvey ex J. Agardh. Since *A. ligulata* was not validly described at the time *Areschougia* was established, the second of the two original species, i. e., *A. Laurencia* (H. f. & H.) Harvey, must be considered the type species of the genus.

In this connection, it is of interest to follow up the disposition of *Halymenia australis* (Sonder) Sonder. The genus *Stenocladia* was founded by J. Agardh in 1872 (p. 44) on two species: *S. furcata* (= *Heringia furcata* Harvey, 1862, *pl. 215*); and *S. conferta* (= *Areschougia conferta* Harvey, 1860, *pl. 166*). The latter species was divided into two varieties: alpha *Cliftoni*, to which was referred *Halymenia australis* (Sonder) Sonder (= *Ginannia australis* Sonder, 1845: 57) with a query; and beta *Harveyi*. In 1876 J. Agardh (pp. 440, 441) split *S. conferta* into four species: *S. corymbosa*, *S. Cliftoni*, *S. Harveyana*, and *S. Sonderiana* (the latter based on *Halymenia aus-*

tralis). Kylin (1932: 50) reunites these four species under the name *S. conferta* (Harvey) J. Ag. The specific epithet *australis*, however, is older, dating from 1845 (as *Ginannia australis* Sonder), and hence this species should be known as *Stenocladia australis* (Sonder) Silva comb. nov. Schmitz (1889: 443) designated *S. Harveyana* as the type species of the genus. If Kylin is followed, then *S. australis* becomes the type. The complete synonymy is as follows:

***Stenocladia australis* (Sonder) Silva comb. nov.**

Ginannia australis Sonder, Bot. Zeit. 3 (4): 57. 1845.

Halymenia australis (Sonder) Sonder, Pl. Preiss. 2: 173. 1847.

Scinaia australis (Sonder) Trevisan, Alg. coco. 105. 1848.

Euctenodus australis (Sonder) Kützing, Sp. alg. 770. 1849.

Phacelocarpus australis (Sonder) J. Agardh, Sp. alg. 2(2): 649. 1852.

In the sense of Kylin (1932: 50) including also:

Areschougia conferta Harvey, Phyc. austral. 3, pl. 166. 1860.

Stenocladia conferta (Harvey) J. Agardh, Bidrag 45. 1872.

Stenocladia conferta (Harvey) J. Agardh var. *Cliftoni* J. Agardh, loc. cit.

Stenocladia conferta (Harvey) J. Agardh var. *Harveyi* J. Agardh, loc. cit.

Stenocladia corymbosa J. Agardh, Sp. alg. 3(1): 440. 1876.

Stenocladia Cliftoni (J. Agardh) J. Agardh, loc. cit.

Stenocladia Harveyana J. Agardh, loc. cit.

Stenocladia Sonderiana J. Agardh, op. cit.: 441.

PHACELOCARPUS Endlicher et Diesing (Sphaerococcaceae), Bot. Zeit. 3(17): 289. 1845.

versus

***Ctenodus* Kützing, Phyc. gen. 407. 1843.**

Type species: *Phacelocarpus tortuosus* Endlicher et Diesing, loc. cit.

Kützing founded the genus *Ctenodus* (1843b: 407) to receive *Fucus Labillardieri* Turner (1811: 8, pl. 137). In 1845 Endlicher and Diesing (p. 289) established the genus *Phacelocarpus*, based on a plant from Port Natal, communicated by Pöppig, which was described as *P. tortuosus*. In 1847 Kützing (p. 5) changed the name of *Ctenodus* to *Euctenodus*, believing the former name to be illegitimate because of the existence of *Ctenodus* Agassiz (1838: 137), a genus of extinct fish. J. Agardh (1852: 646) united the two genera under the name *Phacelocarpus*, although *Ctenodus* had priority. Later (1876: 399, 400) he divided the combined genus into two subgenera: *Euctenodus*, containing the five Australian species known at that time; and *Phacelocarpus*, comprising the South African species, *P. tortuosus*. Subsequently many other species have been added to the genus, which is now placed in the Sphaerococcaceae. Because of the rather large size of this genus, it seems desirable to retain its present well-known name.

HETEROSIPHONIA Montage (Dasyaceae), Prodr. phyc. antaret. 4. 1842,
versus

Ellisius S. F. Gray, Nat. arr. Brit. plants I: 333. 1821.

Type species: *Heterosiphonia Berkeleyi* Montagne, op. cit.: 5.

S. F. Gray founded *Ellisius* on two species of *Confervaria*: *C. arbuscula* Brown ex Dillwyn (1807, pl. 85), which is now known as *Callithamnion arbuscula* (Brown ex Dillwyn) Lyngbye (1819: 123); and *Confervaria coccinea* Hudson (1778: 603 = *C. plumosa* Ellis, 1768: 424, pl. 18, f. c, C, d, D), which is now known as *Heterosiphonia plumosa* (Ellis) Batters (1902: 83). Since *Ellisius* is more recent than *Callithamnion* but older than *Heterosiphonia*, it follows that *Heterosiphonia* is illegitimatized by *Ellisius*. *Heterosiphonia* is a large and widespread genus. It has been especially studied by Falkenberg (1901), Mangenot (1924), and Rosenberg (1933). Inasmuch as *Ellisius* has never been adopted, it would seem advantageous to propose *Heterosiphonia* for conservation against it.

CRYPTOPLEURA Kützing (Delesseriaceae), Phyc. gen. 444. 1843.

versus

Cryptopleura Nuttall, Trans. Am. Philos. Soc. ii, 7: 431. 1841.

Type species: *Cryptopleura ramosa* (Hudson) Kylin in Newton, Handbook 332. 1931. *Cryptopleura lacerata* (Gmelin) Kützing, loc. cit.

Kützing founded the genus *Cryptopleura* (1843b: 444) on the basis of *Fucus laceratus* Gmelin (1768: 179 pl. 21, f. 4) as interpreted by Turner (1808: 151, pl. 68). Turner's plant had previously been described as *Ulva ramosa* by Hudson (1762: 476).

The name *Cryptopleura* was preoccupied, however, inasmuch as Nuttall had given that name to a genus of Compositae from California in 1841. Nuttall's genus never included more than the type species, *C. californica*, and was soon reduced, first to *Troximon* Nuttall (1813) and then to *Agoseris* Rafinesque (1817). On the other hand, Kützing's *Cryptopleura*, largely through the morphological studies of Kylin (1924), has become a very well-known genus in the Delesseriaceae and now includes at least eight species. It seems desirable, therefore, to propose *Cryptopleura* Kützing for conservation.

THAMNOCARPUS Harvey in Hooker (Ceramiaceae), Icones plant. 7, pl. 662. 1844.

versus

Thamnocarpus Kützing, Phyc. gen. 450. 1843.

Type species: *Thamnocarpus Gunnianus* Harvey in Hooker, loc. cit.

Kützing established a genus *Thamnocarpus* (1843: 450) to receive *Fucus cornutus* Turner (1819: 152, pl. 258). A year later Harvey described a genus *Thamnocarpus* which was based on a plant collected at Port Arthur, Tasmania, by Ronald Gunn (in Hooker, 1844, pl. 662). In 1849 Kützing rectified this situation by substituting the

name *Carpothamnion* for Harvey's genus (p. 668). At the same time he added two more species to his own *Thamnocarpus* (1849: 386). J. Agardh (1851: 102) adopted Harvey's *Thamnocarpus* and reduced (1852: 404) Kützing's *Thamnocarpus* to the rank of a subgenus under *Plocamium* Lamouroux (1813: 137). All subsequent workers with the exception of Kützing have followed J. Agardh's lead. Harvey's *Thamnocarpus* has been expanded to include five species. Inasmuch as it has been in use for nearly a century, it seems desirable to conserve this well-known generic name.

EUZONIELLA Falkenberg (Rhodomelaceae), Rhodomel. 360. 1901.

versus

Dasyclonium J. Agardh, Anal. alg. Cont. II: 30. 1894.

Type species: *Euzoniella incisa* (J. Agardh) Falkenberg, op. cit.: 361.

Polyzonia incisa J. Agardh, Linnaea 15: 24. 1841.

Dasyclonium was established by J. Agardh to receive his new species, *D. acicarpum* (1894: 81), based on a plant from Port Phillip, Australia, sent by J. Bracebridge Wilson. It was described from stichidial material only. Falkenberg (1897: 464) reduced *Dasyclonium* under *Polyzonia* Suhr (1834b: 739). Later (1901: 360) he erected *Euzoniella* to encompass seven species which formerly had been placed in *Polyzonia*. Falkenberg named *Euzoniella incisa* (J. Agardh) Falk. as the type species of his genus. Simultaneously, however, he reduced *Dasyclonium acicarpum* J. Agardh to synonymy under *Euzoniella incisa*, thus indicating the illegitimacy of his own genus. *Euzoniella* is widespread in the Australia-New Zealand area and has become rather well-known, in part because of the singular beauty of its members. Studies have been made by Connolly (1911) and Cuoghi-Costantini (1912) in addition to Falkenberg. In the interests of nomenclatural stability, therefore, *Euzoniella* is proposed for conservation.

LENORMANDIA Sonder (Rhodomelaceae), Bot. Zeit. 3: 54. 1845.

versus

Lenormandia Delise in Desmazières, Pl. crypt. France, ed. 1, no. 1144. 1841.

Lenormandia Trevisan, Atti IV Riun. Sci. Ital. 332. 1843.

Lenormandia Montagne, Ann. Sci. Nat. Bot. iii, 1: 158. 1844.

Type species: *Lenormandia spectabilis* Sonder, loc. cit.

The case for the conservation of *Lenormandia* Sonder is presented under *Areschougia* Harvey.

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Contributions to our knowledge of British Algae

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XI. A new colonial *Pinnularia* (*P. cardinaliculus* Cl. emend).

The cells ($56\text{-}130\mu$ l.; $14\text{-}22\mu$ br.) are united along their girdles to form colonies of two to six cells, all of the same size. In about 90% of a population there are 4 cells per colony. Solitary living cells are very rare. Owing to the curvature of the colonies (fig. 1, F, G) not all the cells appear in valve view. Usually, in about 80% of the four-celled colonies, the two central cells (*b*, *c* in fig. 1, G) are seen in valve view (fig. 1, H), while the outside cells (*a*, *d* in fig. 1, G) appear at a higher or lower plane of focus in more or less oblique girdle view, according as the colony is observed from its concave or convex side. This is so when the two central cells or the two outside cells are in contact with the substratum. If one outer cell only (e.g. *a* or *d* in fig. 1, G) touches the substratum, then the three others appear more or less in girdle view, and if two cells to one side are in contact with it (e.g. *a*, *b* in fig. 1, G), then the two others (e.g. *c*, *d* in fig. 1, G) appear more or less in girdle view.

There is no mucilage investment to the colony as a whole. Its curvature is due to the cells being connected along only a part of the girdle face (fig. 1, F, G). No mucilage can be detected in these areas of attachment, nor are connecting teeth (as in *P. Debesii* Hustadt 1926, 1930, fig. 612) or other siliceous structures visible on the girdle face of the separate cells. Dead cells occasionally occur in colonies attached to living cells, but intact colonies in which all the cells are dead are very rare. This suggests that the binding substance is soon lost or broken. The cells can be separated by vigorous shaking, by pressure on the cover glass and by gentle boiling with acids. Though this behaviour suggests that the cementing substance is not silica, both such treatment and the wave-induced movements of the substratum, on which *P. cardinaliculus* grows in nature, might be sufficient to break a weak siliceous cement.

Mud bearing a rich population was inoculated into a flask containing a solution of beef extract (0.3%) and peptone (0.5%) and

left in the dark at 20°C for two weeks, by which time a vast growth of bacteria had developed. Although there had been no agitation of the flask, all the colonies were dead and had disintegrated into their component cells, presumably owing to bacterial decomposition of the cementing substance. If this be so, it can hardly be silica, but may well be some form of mucilage.

The valves of the larger cells are very slightly wider at the poles than in the middle, but those of the smaller ones are definitely linear (fig. 1, A-E). The raphe is straight and simple, the branches curving to the same side at the central and polar nodules. The axial area is about one-third the width of the valve; the central area forms a somewhat narrow transapical fascia. The simple striae (7.5-8.5 in 10μ) are radial in the middle and parallel to weakly convergent near the poles of the larger valves (fig. 1, B, C); with decreasing size the degree of radiation in the centre and of convergence at the poles becomes less (fig. 1, E), though only the latter disappears completely. The striae lie within a siliceous ledge, which reaches only a short distance beyond their inner margin to end in a smooth straight (fig. 1 A, C, E) or more or less wavy (fig. 1, C) or even serrate (fig. 1, D) edge, parallel to the apical axis, the type of edge often varying on each side of one and the same cell (fig. 1, B-D). Opposite the central nodule there may be one or more irregular holes (fig. 1, A-D) in the ledge, while small isolated fragments may occur outside the general margin (fig. 1 D).

Pinnularia cardinaliculus is a common and occasionally abundant diatom on the littoral deposits of certain lakes in the English Lake District, viz. Windermere (where the colonies were first observed in 1945), Esthwaite Water, Blelham Tarn, Loughrigg Tarn, Rydal Water, Elterwater (F.E. Round) and Grasmere (F. E. Round), all of which belong to the same (Windermere) drainage system. Mr. F. E. Round, who is studying bottom-living algae, informs me that he has not observed it in any other of the lakes in this district. It is possible, therefore, that it is confined to this one drainage system. Cleve (1894-95, p. 79) records it from Scotland, Canada, U.S.A., and Mexico. Dr. Hustedt (private communication) informs me that *Neidium Hitchcocki* (Ehr.) Cl., which commonly accompanies *P. cardinaliculus* on the deposits of these lakes, has a similar geographical distribution.

Pinnularia gibba Ehr. var. *linearis* Godward (1937, p. 556, fig. 16), only recorded from Windermere, appears to be founded on dead cells of this species.

P. cardinaliculus is described and figured by Cleve (1894-95, Pt. II, p. 79, Pl. I, fig. 12) as a non-colonial species with perfectly linear valves which are without the ledge within which the striae lie. I am greatly indebted to Dr F. Hustedt for pointing out that the English specimens are indeed identical with this species and for sending me a slide of material from Crane Pond, Mass., U.S.A., one

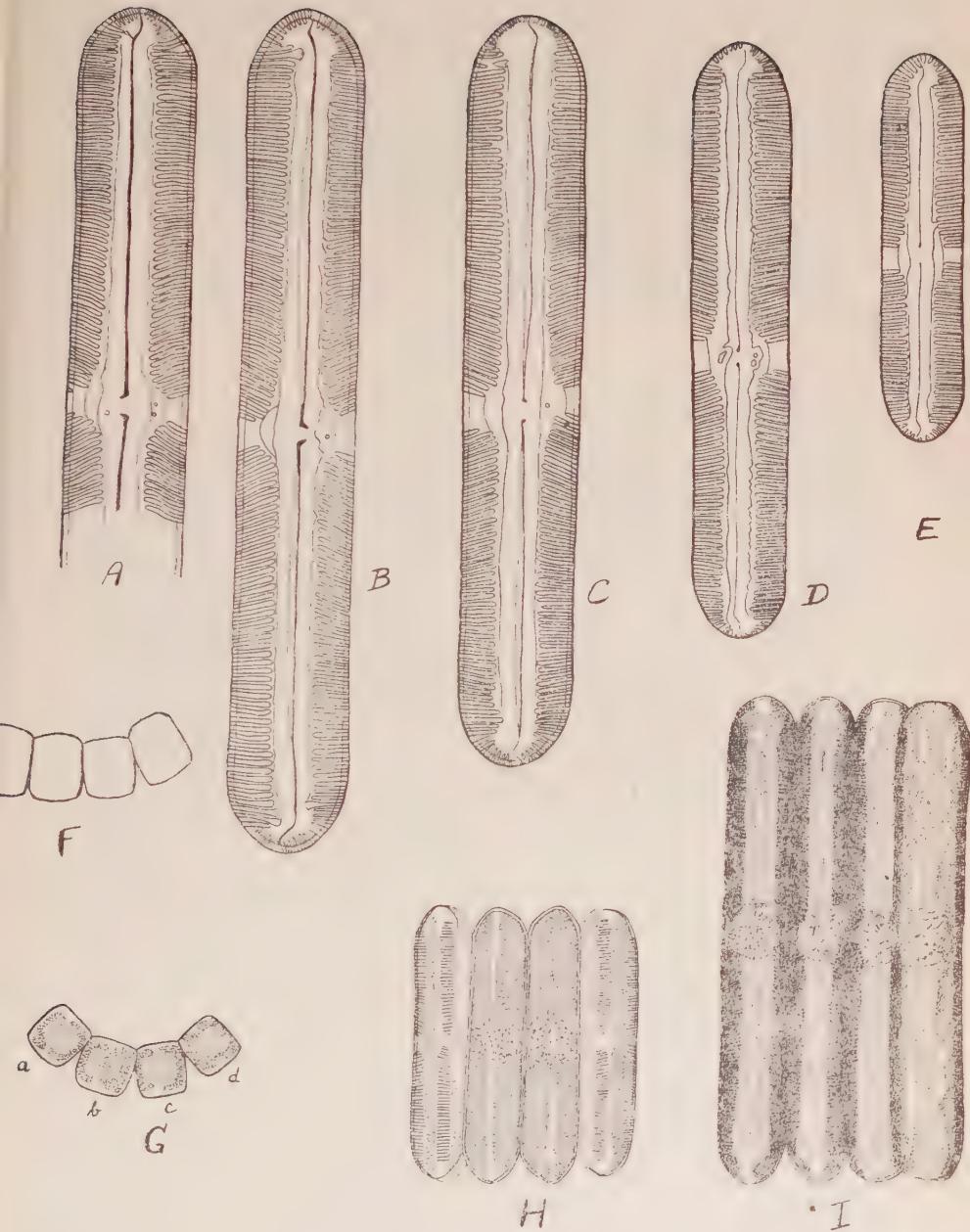


FIGURE 1. *Pinnularia cardinaliculus* Cl. emend *A—E*, valves of diverse sizes; *F—I*, colonies. *F, G* viewed in the transapical (i.e. from the poles), and *H, I* in the valvar planes (i.e. in surface view). The cells in *G* are labelled *a, b, c* and *d* to facilitate the explanation of their appearance (see text). *A—E* x 800; *F—G* x 375; *H—I*, x 575.

of the type localities. He suggested, in relation to *P. latevittata* Cl. (Hustedt 1926), that further species, originally described as non-colonial from cleaned or dead material, might prove actually to be colonial. *P. cardinaliculus* differs in its valve markings from *P. latevittata* Cl. (Cleve 1894-95; Schmidt, 1874-1938, pl. 42, fig. 5; Hustedt 1926) and other colonial species (Hustedt 1926). It differs in the type of colony from *P. Debesii* Hust. (1926, 1930) and in valve-shape from *P. socialis* Palmer (1910, 1911 a, b). The colonies of the latter are also curved (Palmer 1911 b).

Material and slides are lodged with the Freshwater Biological Association.

DIAGNOSIS

Pinnularia cardinaliculus Cl. emend. Cells (56-130 μ l.; 14-22 μ br.) joined along part of the girdle to form curved colonies, usually of 4, but sometimes of 2-6 cells. Solitary living cells very rare. Valves linear with broadly rounded or slightly inflated poles. Simple raphe. Axial area about one-third the width of the valve, central area a transapical fascia. Transapical striae (7.5-8.5 in 10 μ) simple, radial in the middle, convergent to parallel near the poles, lying within a ledge running parallel to the apical axis of the cell. Common on the littoral deposits of certain lakes in the English Lake District.

Pinnularia cardinaliculus Cl. emend. Zellen (56-130 μ l; 14-22 μ br.) durch einen Teil der Gürteleite zu gekrümmten Bändern verbunden, gewöhnlich aus vier, zuweilen aus zwei bis sechs Zellen bestehend. Einzeln lebende Zellen sehr selten. Schalen linear mit breit gerundeten oder leicht transapikal erweiterten Enden. Raphe einfach. Längsarea etwa ein Drittel der Schalenbreite einnehmend, Zentralarea eine Querbinde. Transapikalstreifen (7.5-8.5 in 10 μ) nicht von einem Längsband gekreuzt, kräftig, in der Mitte radial, an den Enden wenig konvergent oder fast parallel, in einem Vorsprung dessen innere Grenze parallel mit der Apikalebene verläuft liegend.

Häufig im littoralen Grundschlamm gewisser Seen Nord Englands.

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Additions to knowledge of moss-dwelling fauna of Switzerland.

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(From zoological Institution of pedagogical faculty of Charles University. Nro 5)

Prof. Dr. O. JIROVEC was so kind to give me 24 mossprobes collected by him on the voyage in Switzerland during the months August and September 1948.

These moss-probes are collected on enumerated localities. The number inducing each locality is used in following paper instead the name of locality. The numbers in brackets used in enumeration of the localities mark out the number of collected species of Rhizopoda, Rotatoria, and Tardigrada.

1. Castagnola: 9. 8. 1948. (6, 10, 6).
2. Lausanne: 22. 8. 1948. (4, 8, 3).
3. Grimmsel pass: 28. 8. 1948. (1, 2, 0).
4. Grimmsel pass over the glacier: 28. 8. 1948. (13, 10, 0).
5. Water falls of Rhône: 28. 8. 1948. (9, 9, 1).
6. Glacier du Rhône: 28. 8. 1948. (1, 2, 0).
7. Interlaken: 29. 8. 1948. (0, 2, 3).
8. Ospizio Bernina: 2309m: 30. 8. 1948. (6, 5, 1).
9. Bernina pass by ospizio: 2256m: 30. 8. 1948. (2, 3, 0).
10. Morteratsch by lift on glacier: 30. 8. 1948. (2, 2, 1).
11. Borallhütte under Bernina: 2459m: 30. 8. 1948. (5, 3, 2).
12. From Borallhütte on Pic Bernina: 31. 8. 1948 (10, 8, 4).
13. Fiorca Surley over Pontrezina: 2760m: 1. 9. 1948. (8, 7, 0).
14. Pontrezina in wood: cca 1900m: 1. 9. 1948. (15, 8, 4).
15. Coazhütte (Bernina): 2390m: 1. 9. 1948. (6, 8, 3).
16. St. Moritz: 1790m: 2. 9. 1948. (12, 3, 4).
17. Campferer See by St. Moritz: 2. 9. 1948. (7, 7, 5).
18. Water falls of Rhine I. (1, 2, 1).
19. Water falls of Rhine II. (5, 5, 0).
20. St. Gallen: 4. 9. 1948. (0, 2, 0).
21. Chur, on wall of bishop's castle: 4. 9. 1948. (1, 3, 0).
22. Basel: 6. 9. 1948. (3, 2, 0).
23. Zürich. I. / periphery / (1, 2, 1).
24. Zürich. II. City; on wall of a garden: (7, 3, 0).

I studied only Rhizopoda, Rotatoria, and Tardigrada. In all examined moss-probes are determinated 30 Rhizopoda, 38 Rotatoria, and 19 Tardigrada species. From these 87 moss-dwelling species two are new for science. They are: *Pleuretra hystrix* n. sp. and *Pleuretra sulcata* n. sp.

Rhizopoda.

The rhizopodial fauna of studiated mosses belongs principally to the banal moss dwelling element of Rhizopoda. From the typically bryobiont forms only *Amphizonella violacea*, *Diplochlamys leidyi*, and *Corycia flava* are found. While the moss-probes were in the greatest part aerophytic, the Rhizopods of them belong to the „dampy moss” associations. These associations are represented firstly in occurring of a large copy of individuals of some *Centropyxis* species, as *C. aerophila*, *C. eurystoma*, *C. kahli*, *C. ecornis* in all mosses, to which are added in the much drying mosses yet *C. labiata* and in the dampier one *C. platystoma*, and *C. constricta*. To these *Centropyxis* species are accompanied in the much dry mosses also *Trigonopyxis arcula* and *Bullinula indica*, but in the dampier mosses various species of the genera *Nebela*, *Euglypha*, *Heleopera*, *Corythion dubium*, *Trinema complanatum*, and *Difflugia lucida*. The eurytopic species as *Trinema enchelys*, *Nebela collaris*, *Assulina muscorum* and *Eugl. ciliata* in all moss-probes.

1. *Amoeba verrucosa* EHREG. (1, 4, 5, 8, 14, 15, 16, 17; 19, 21, 24). Firstly in the mosses from sunny localities. In some moss-probes very frequent.
2. *Amphizonella violacea* GREEFF. (1, 4, 16). Typical for the mosses exposed to the sun rays.
3. *Arcella arenaria* GREEFF. (2, 4, 5, 8, 12, 13, 14, 15, 16, 18, 22, 24). This species occurs very frequent in all probes of aerophytic mosses.
4. *Assulina muscorum* GREEFF. (4, 5, 10, 11, 14, 17). In all mosses, but in the aerophytic much frequently than in the hygrophytic one.
5. *Assulina seminulum* EHREBG. (14). In dampy moss. It occurs customary in hygrophytic mosses much frequently than in the aerophytic.
6. *Bullinula indica* PENARD. (14). In aerophytic moss. HOOGENRAAD find this species firstly in *Sphagnum*. But I can it in Czechoslovakia only from the mosses collected on stones from localities exposed the full day to the sun rays and winds.
7. *Centropyxis aerophila* DEFL. (3, 4, 8, 9, 12, 13, 14, 16, 17, 22, 24). Very frequent in aerophytic mosses.
8. *Centropyxis constricta* EHREBG. (4, 5). In the dampy and hygrophytic mosses.

9. *Centropyxis ecornis* DEFL. (1, 24). In dry mosses.
10. *Centropyxis eurystoma* DEFL. (4, 5, 8, 10, 11, 12, 14, 16, 17). In aerophytic mosses, sometimes very frequent.
11. *Centropyxis kahli* DEFL. (4, 9, 14, 15, 18). In aerophytic mosses.
12. *Centropyxis labiata* PENARD. (5). In aerophytic moss.
13. *Centropyxis platystoma* DEFL. (5, 14). In dampy mosses aerophytic, much frequently in hygrophytic.
14. *Corycia flava* GREEFF. (1, 2, 8, 11, 15, 16, 23). Typical bryobiont species. It occurs firstly in the aerophytic mosses exposed the full day to the sun rays and winds.
15. *Corythion dubium* TARANEK. (4, 6). It occurs in dampy aerophytic and firstly in hygrophytic mosses.
16. *Diplochlamys leidyi* GREEFF. (1, 16, 17). Typical bryobiont form. In drying mosses exposed to the sun rays.
17. *Diffugia lucida* PENARD. (13). This species occurs frequently in the dampy and firstly in the hygrophytic mosses on strands of streams and brooks.
18. *Euglypha ciliata* EHRBG. (2, 4, 14, 17, 18, 24). This species belongs to the eurytopic element occurring in all mosses and also in the water.
19. *Euglypha laevis* PENARD. (11). In dampy moss.
20. *Euglypha strigosa* PENARD. (4). In dampy moss.
21. *Heleopera petricola* PENARD. (1, 12, 18). This species occurs in the hygrophytic mosses on strands of streams and other water basins.
22. *Heleopera picta* PENARD. (12). So as precedent species.
23. *Nebela collaris* EHRBG. (12, 13, 14, 15, 17). It occurs in all sortes of mosses and also in water.
24. *Nebela dentistoma* PENARD. (12, 16). This species lives usually in the very dampy mosses or in hygrophytic mosses on strands of various water basins.
25. *Nebela lageniformis* PENARD. (13, 17). In dampy and hygrophytic mosses.
26. *Nebela penadiana* DEFL. (Syn.: *americana* Taraneck). (12). In hygrophytic mosses.
27. *Nebela tubulosa* PENARD. (12, 13). In hygrophytic mosses.
28. *Trigonopyxis arcula* LEIDY. (14, 16, 24). In aerophytic often drying mosses.
29. *Trinema complanatum* PENARD. (14, 16). In dampy aerophytic and hygrophytic mosses.
30. *Trinema cnchelys* EHRBG. (4, 5, 11, 13, 14). It occurs in all sortes of mosses and also in water.

Rotatoria.

Between very frequent individuals of various species of Bdelloidea were found some individuals of two species of Monogononta. Both these species are found in the same moss probe, collected on stone

by the water falls of Rhône. In mosses, which are regularly irrigated by the water of water falls occur customary Monogenonta species. This fact I constated also in High Tatra mosses probes. (1948).

1. *Adineta barbata* JANSON. (1, 4, 13, 15, 18, 24). In all mosses.
2. *Adineta gracilis* JANSON. (4, 7, 8, 12, 15, 17). In the dampier mosses it occurs much frequently.
3. *Adineta vaga* DAVIS. (1, 2, 4, 5, 6, 13, 14, 18, 23). In all sorts of mosses.
4. *Ceratotrocha cornigera* BRYCE. (12). In dampy moss.
5. *Colurella gastracantha* HAUER. (5). In the moss-sample collected by the water falls of Rhône with several individuals of *Mono-styla lunaris*.
6. *Habrotrocha aspera* BRYCE. (8, 11). In drying mosses.
7. *Habrotrocha bidens* MILNE. (1, 2, 4, 8, 11, 13, 16, 17, 18, 22). Very frequent in various sorts of mosses.
8. *Habrotrocha elegans* MILNE. (2, 14, 21). In drying aerophytic mosses.
9. *Habrotrocha flava* BRYCE. (24). In drying aerophytic wood mosses.
10. *Habrotrocha fusca* BRYCE. (2, 12). Firstly in often dry aerophytic mosses.
11. *Habrotrocha insignis* BRYCE. (1, 12). In mosses exposed to sun rays and winds.
12. *Habrotrocha ligula* BRYCE. (12). So as precedent.
13. *Habrotrocha spicula* BRYCE. (14). In drying aerophytic mosses.
14. *Habrotrocha tridens* MILNE. (4, 15). Drying mosses.
15. *Macrotrachela ehrenbergi* JANSON. (2). In dry moss.
16. *Macrotrachela habita* BRYCE. (12, 16). In dry mosses.
17. *Macrotrachela musculosa* MILNE. (15). Dry moss.
18. *Macrotrachela nana* BRYCE. (2, 3, 4, 5, 7, 9, 22). In aerophytic mosses. It is recognisable firstly on its very frequent eggs with characteristical outgrowths.
19. *Macrotrachela papillosa* THOMPSON. (8, 13, 17, 18). In drying mosses, in some probes very frequent.
20. *Macrotrachela plicata* BRYCE. (1, 4, 9, 10, 12, 15). In aerophytic as in hygrophytic mosses, sometimes very frequent.
21. *Mniobia incrassata* MURRAY. (17, 19). In dry mosses.
22. *Mniobia magna* PLATE. (15). In aerophytic dry moss.
23. *Mniobia russeola* ZEL. (1, 14). In dry aerophytic mosses.
24. *Mniobia scarlatina* EHBRG. (4). In dry moss.
25. *Mniobia symbiotica* ZEL. (3, 5, 8, 9, 10, 12, 13, 14, 15, 17, 20, 21). In various sortes of mosses. It does not to live symbiotic with hepaticas as means ZELINKA. It lives in all sortes of mosses between the leaves of them. This fact constate at last time also other investigators in Bdelloidea (VARGA, PAWLOWSKI).
26. *Mniobia storkáni* BARTOS. (1, 5). This very interest species pro-

tected by a slimy cover as *Rotaria sordida* WEST. lives not only in Bohemia. It was detected by me also in High Tatra in Slovakia and now also in Switzerland.

27. *Mniobia tetraodon* EHRBG. (4, 11, 14, 17). In dry mosses. This species forms in the drying mosses typical kysts described by BARTOS in 1941. These kysts are observed in moss-sample Nro: 14.
28. *Monostyla lunaris* EHRBG. (5). Aquatic species which occurs very often also in the mosses of inundations.
29. *Otostephanos torquatus* BRYCE. (5). In hygrophytic moss.
30. *Philodina nemoralis* BRYCE. (4, 5) In dampy aerophytic and hygrophytic mosses.
31. *Philodina plena* BRYCE. (1, 5, 6). In aerophytic so as in hygrophytic mosses. In moss probe Nro: 5 are very numerous eggs of this species.
32. *Philodina rugosa* BRYCE. (14). In dry moss.
33. *Philodina vorax* JANSON. (1, 2, 13). In aerophytic mosses.
34. *Pleuretra alpium* EHRBG. (2, 12, 15, 17, 18, 23, 24). In dry mosses very frequent.

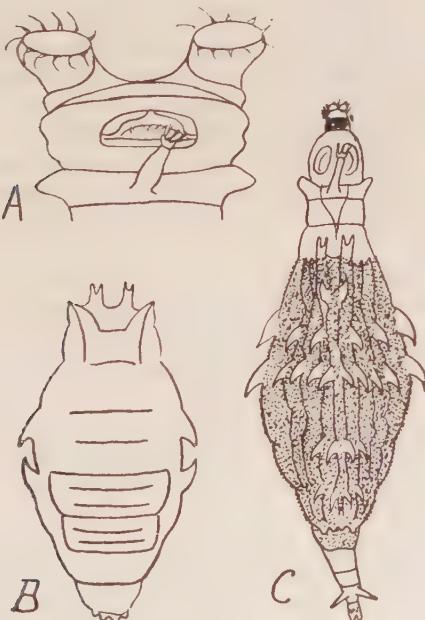


Fig. 1. *Pleuretra hystrix* n. sp. A. Feeding head, dorsal view. B. Contracted, belly view. C. Creeping animal, dorsal view.

35. *Pleuretra brycei* WEBER. (21). In water mosses, also in the hygrophytic mosses firstly in the inundation of brooks.
36. *Pleuretra hystrix* m.n. sp. Fig. 1 A-C.

In mosses sample Nro 12 collected by Prof. Dr. O. JIROVEC on excursion from Borallhütte to Pic Bernina are found between numerous individuals of *Pleuretra alpium* also several individuals of another species of this genus, which is new for science.

The length of the body attains $180\text{-}230\mu$. The head, the neck, and the foot with the spurs are smooth. The surface of the trunk is covered with fine and dense cuticular corners. The body is colourless and transparent.

The rostrum is two-jointed, short and it bears two semicircular rostral lamellae. On each flank of the base of dorsal antenna sets a prominent lateral knob. The dorsal antenna is very long. It equals the diameter of the neck. On the dorsal side of the trunk are 14 longitudinal folds. On the belly side of the trunk are 10 very well developed cross ribs. The anterior margin of the trunk runs dorsally in two median dichotomous spines. Two other spines, which are also sharply pointed set on the ventral anterior margin of the trunk. These ventral spines are separated by a very wide and straight interspace. From the tips of both ventral spines run longitudinal folds backwards to the first cross ridge, which is very short. On the dorsal surface of second, third, fourth, and fifth trunk segments the dorsal longitudinal ridges run out on the posterior margins in large and acute spines. These spines make also four cross bands. To these four backwards aiming spinerows acced yet two rows of spines on the anterior margins of the first and second trunk segments and one row on the first of $1/3$ of the third trunk segment. These spines run forwards. There are also 7 cross bands of spines on dorsal surface of the trunk.

The foot is four-jointed, without dorsal knob, which is customary developed by other species of this genus. The spurs are short, sharply conical and they are separated by a straight and wide interspace. There are two pairs of toes. The dorsal pair is much slender and shorter than the ventral one.

The head of the feeding animal is very broad, but it is short. The wheel-discs are separated by a wide and deep sulcus. The collar is feebly developed. The upper lip is slowly arched.

Dental formula: 2/2.

Habitat: drying mosses.

Locality: Pic, Bernina, Switzerland, 31. VIII. 1948.

This new species belongs to the group of *Pleuretra* species, which bear several cross rows of spines on the trunk. They are: *Pl. brycei*, *Pl. reticulata* MILNE, *Pl. costata* BARTOS, and *Pl. africana* MURRAY.

From *Pl. costata* the new species differs in the form of the spines. By *Pl. costata* they are developed on all dorsal folds and they are

united with these folds in a forme of two-jointed costa. In *Pl. costata* are the dorsal longitudinal folds high and flattened from the sides.

Pl. reticulata lacks the spines on the anterior margin on the first trunk segment. On the dorsal surface are developed 7 rows of spines.

Pl. africana possesses only 5 transversal rows of spines on the trunk.

Very near is the new species to *Pl. brycei*. It differs from it in the developing of lateral knobs on both sides of the antennal base, which are lacking by *Pl. brycei*. New species possesses much cross series of spines as *Pl. brycei*.

37. *Pleuretra sulcata* m.n. sp. Fig. 2 A-C.

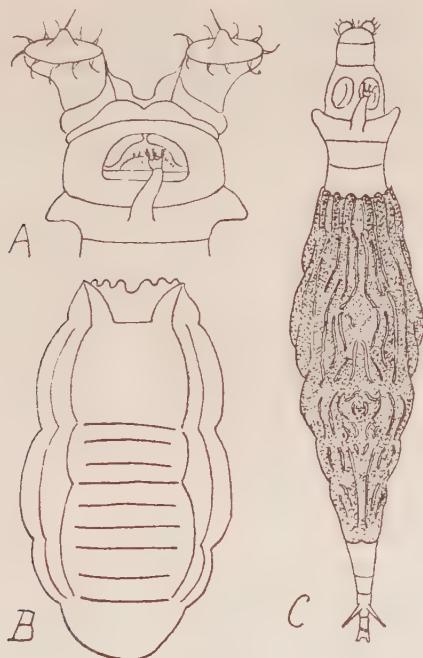


Fig. 2. *Pleuretra sulcata* n. sp. A. Feeding head, dorsal view. B. Contracted, belly view. C. Creeping animal, dorsal view.

In moss samples Nros 14 and 16 are found several individuals of another species of this genus, which canot be arranged to any of the known species of genus *Pleuretra*.

The vively reddish coloured body attains the — length of 300u --- 350 μ .

The cuticula, chiefly on the trunk, is thick, on the trunk it is

cornered, but the surface of the head, of the neck, and of the foot with spurs is smooth. On the dorsal surface of the trunk are several longitudinal and broad cuticular folds. On the belly side of the trunk are 9 very well developed cross ridges. The anterior dorsal margin of the trunk runs in 6 large and semicircular knobs. On the ventral anterior margin of the trunk set two much larger, but sharply pointed spines. From the tips of these spines run backwards longitudinal folds to the first and short cross ridge. The ventral spines are separated by a straight and wide interspace.

Rostrum is two-jointed. It bears two semicircular and separated rostral lamellae. The stiff, long tactil ciliae are well developed. The propre head is broad, with well distinct retracted wheel-disc. On the first neck segment are two very large lateral knobs on the sides of base of dorsal antenna. Dorsal antenna is long, two-jointed, and it equals $1\frac{1}{2}$ - $1\frac{3}{4}$ of the neck diametre. The slender foot consists of four segments. On the third foot-segment set two long and slender conical spurs, which are sharply pointed. They are separated by a small interspace. This foot is terminated by two unequal pairs of toes. The superior pair of toes is much shorter and slender than the inferior one. The superior toes are very approximated, the inferior one widely distant.

By the feeding action appears the broad wheel organ. It is much broader than the diametre of the head. The wheel-discs are widely distant and they are separated by a broad and deep wheel-sulcus. On the surface of each wheel-disc sets a large sensitive papilla with a long tactil seta. The wheel pedicels run backwards together. The collar forms on each wheel-pedicel a distinct basal border and it passes in a semicircular wheel retractor. The upper lip is arched and it forms two median circular lobes. The lateral knobs of the first neck segment form on the feeding head the latero-posterior backwards aiming edges.

Dental formula: 2/2.

Habitat: drying mosses.

Localities: Pontresina, St. Moritz; Switzerland. 1948.

This species belongs to the group of *Pleuretra* species, which lack the dorsal spines on the trunk, with exception of the anterior margin of it. To this group belong also *Pl. alpium*, *Pl. intermedia* BARTOS, *Pl. humeralis* MURRAY, and *Pl. triangularis* MURRAY.

From *Pl. intermedia* the new species differs in lacking of two spines on foot segments and several other signs.

From *Pl. triangularis* *Pl. sulcata* differs in the form of the body and in the cross section of the longitudinal folds. These are by *Pl. triangularis* triangular acute, by *Pl. sulcata* broad and obtuse.

From *Pl. humeralis* differs the new species by the very well developed knobs by the base of antenna, these are lacking by *Pl. humeralis*. The surface of the trunk is by *Pl. humeralis* very roughly, by *Pl. sulcata* only finely cornered.

This new species is near est to *Pl. alpium*. From this it differs in the developing of the lateral knobs by the base of antenna, and also the dislocation the ventral ribs is another as by *Pl. alpium*.

38. *Rotaria sordida* WESTERN. (19, 20). In aerophytic mosses. In the moss sample Nro 19 all studiated individuals are protected by a slimy cover forming a plate armour, similar to this of *Dissotrocha macrostyla* or *Mniobia incrassata*. Such similar armours I know also from some individuals of *Habrotrocha spicula* BRYCE or *Macrotrachela papillosa* THOMPSON from Czechoslovakia.

Tardigrada.

Tardigrada do not be found in all moss samples. The majority of species occurs only on 1 or 2 localities. Seldom few species are much distributed.

1. *Bryodelphax parvulus* THULIN. (12, 16). In dry mosses.
2. *Echiniscus blumi* RICHT. (14, 17). Drying mosses.
3. *Echiniscus merokensis* RICHT, typ. (2, 7). Dry moss.
- o. *Echiniscus merokensis* for. *suecicus* THULIN. (1, 15). Drying mosses.
5. *Echiniscus trifilis* CUENOT. (1). Drying mosses.
6. *Echiniscus trisetosus* CUENOT (8, 12, 14, 15, 17). In the moss-probe Nro 17 are found several individuals which bear on the left side the appendages of typical *Ech. blumi* and on the right side this of *Ech. trisetosus*.
7. *Echiniscus wendti* THULIN. (11). In dry mosses.
8. *Hypsibius alpinus* PLATE. (10) Dampy aerophytic moss.
9. *Hypsibius granulifer* THULIN. (16) Drying moss.
10. *Hypsibius oberhäuseri* DOYERE. (1, 7). Dry mosses.
11. *Hypsibius ornatus* R(CTHERS (17). Dry moss.
12. *Hypsibius ornatus* var. *caelatus* MURRAY. (17). Dry moss.
13. *Hypsibius pallidus* THULIN. (7, 14, 15, 17). In aerophytic mosses.
14. *Macrobiotus coronifer* RICHT. (12, 16). Dry mosses.
15. *Macrobiotus furcatus* EHRBG. (19). In dry moss.
16. *Macrobiotus hufelandii* C. A. S. SCHULTZE. (1, 2, 5, 11, 14, 16, 23). In aerophytic and also in hygrophytic mosses.
17. *Macrobiotus intermedius* PLATE. (12). In dry moss.
18. *Milnesium tardigradum* DOYERE. (1, 2). In dry mosses.
19. *Pseudechiniscus cornutus* RICHTERS var. *lobata* RAMAZZOTTI. (Fig. 3). This very interesting form belongs to the variety described by RAMAZZOTTI from Italian mosses. Our individuals, which are very numerous, differ from the Italian ones in several signs.
 - 1°. By small lateral spines on the posterior lateral edges of the plates D. and F.
 - 2°. The appendages on the sides of the mouth opening are different. Cirrus internus is shortly conical, papilla mediana is hemisphaerical, and cirrus externus is sharply conical and larger than cirrus internus.

- 3°. Papilla cephalica by the base of cirrus lateralis is well visible and broadly cylindrical.
- 4°. On the plate B are two smooth lines corresponding with those of typical species.

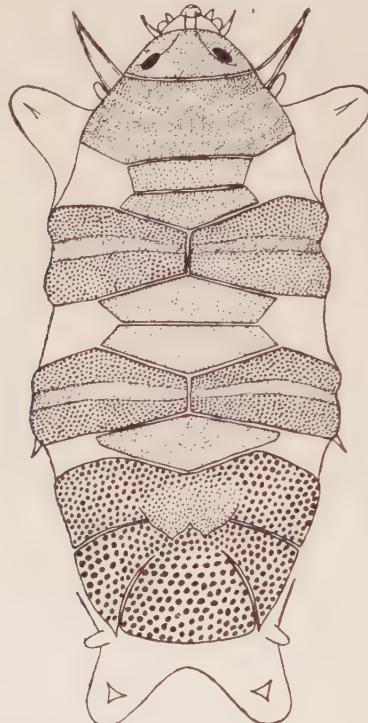


Fig. 3. *Pseudechiniscus cornutus* Richt. var. *lobatus* Ramazzotti from Switzerland.

- 5°. The spines on first pair of feet are much longer.
- 6°. On the plates C and D are the medianes cross depressions well developed, so as they are figured by Richters.
- 7°. On the fourth pair of feet are developed papillae laterales, which are by RAMAZZOTTI drawings lacking, and than also largely triangular appandages on the place of spine comb of *Echiniscus* species.
- 8°. The III. intermediate plate is simple so as by typical forme.
- 9°. All plate are roughly cornered, the corners appear to be larger as by individuals of RAMAZZOTTI.

I call these individuals as *Ps. cornutus* var. *lobata* RAMAZZOTTI, also when they differ in their external habitus in much signs. It is very possible that many of these signs are overlooked.

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Description of three new species of the genus *Monommata*, viz. *M. robusta* n. sp., *M. dissimile* n. sp. and *M. sphagnicola* n. sp.

W. H. SCHUSTER, Over de mogelijkheden ener oestercultuur in Indië, *Landbouw*, 21, 1949, 33-42.

On the possibility of Oysterculture in Indonesia.

Condensed English summary: Oyster culture or collecting taking place in most of the countries surrounding Indonesia, such as Australia and Japan, the writer means that there exist fair possibilities as to the extension of oyster culture to Indonesia, the natural conditions there being favorable; collecting on a small scale occurs on some islands, and on Marunda there seems to exist a primitive form of culture. Particulars are given of the physiology of the oyster, as well of its culture in other countries; some ten species of the genus *Ostrea* are recorded for Indonesia.

P. M. JONASSON, Quantitative studies of the bottom fauna. Reprint from Kaj Berg, Biological studies on the river Susaa, *Folia Limnologica Scandinavica*, No 4, 1948, 294-287, 7 plates, 5 tables.

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J. KORNAS & A. MEDWECKA-KORNAS, Les associations végétales sous-marines dans le golfe du Gdansk (Baltique Polonaise), *Bull. Ac. Pol. Sc. & Lettres, Cl. Sc. Math. et Nat.* (B) 1948, Cracovie 1949, 71-88, 1 carte, tables.

A study on the submarine vegetal associations found in the western portion of the gulf of Gdynia. The associations under review are grouped into a) sea-bottom associations, comprising: 1. *Fuceto-Furcellarietum* n. nov. prov., 2. *Chareto-Tolypelletum* n. nov. prov. and 3. the *Cladophora glaucescens*-group; b) associations found in the sea-havens, comprising: 4. *Enteromorpha Linza* & *Spirulina subsalsa*-group and 5. *Enteromorphetum compressae* n. nov. prov. A brief description of each of the associations is given, with tables

illustrating some of the latter. The authors point out that the association *Enteromorphetum compressae* is the only that seems to possess equivalents outside the Baltic sea.

P. van OYE, Het waterprobleem in België, Verslagen en Voorstellen van de Kon. Vl. Ac. Wet., Lett. & Sch. Kunsten v. België, Kl. Wet. No. 1, 1949, 15 pp.

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O. LHOITSKY, The production of Chlamydospores by *Closterium moniliferum* (BORY) EHRBC., Studia Botanica Cechoslovaca, IX, 2-4, 1948, 155-159, 3 fig., 1 plate.

Description of the chlamydospores produced by *Closterium moniliferum* and of the process of the formation. The permanent cells, both unreduced and degenerated, have been described and named chlamydospores by CZURDA in 1937 in the Zygnemales and the Mesoataeniales. The writer has discovered them in the Desmidiales; he thinks that the cause of their formation are probably unfavorable growing conditions.

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Description of new species of soil-rotifers, viz.: *Scepanotrocha delicata*, *Philodina morigera*, *cristata*, *Ceratotrocha velata*, *franzi*, *Mnioba tarda*, *variabilis*, *tentans*, *Habrotrocha rara*, *serpens*, *solida*, *sollicita*, *crassa*, *filum*, *flavicornis* de CONING (re-description), *soltaria*, *rosa*, *Macrotrachela ornata*, *oblita*, *libera*, *festinans*.

B. DUSSART, Le lac de Vallon, Contribution à l'étude des lacs du Chablais, Académie Chablaisienne, T. 49, 1946, 30 pp., 3 ffig.

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in 1946-47. Meso- and oligosaprobic species characterize the latter lake with *Tabellaria fenestrata* as the dominant representative of the phytoplankton.

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Notes on a number of Crustaceans and Insects collected in the lake Darbon, near the shore. There are no fish in the lake, a fact due to the broad quantitative variations of the zooplankton, the lake being frozen for six months in the year. The possibility to re-populate the lake with fish is examined.

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(Miss) M. NISBET & B. DUSSART, Le plancton dans le lac Léman et ses facteurs de répartition, C. R. s. Ac. Sci., t. 227, 1054-1056, 15 nov. 1948.

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Description of some Hydracarians collected in different parts of Rumania, belonging to the genus *Megapus* Neumann. Eighteen species are described, and the following are new: *P. magnirostris*, *pygmaeus*, *microphtalmus*, *prosiliens*, *elegans*, *sokolowi*, *szalayi*, *phrea-*

ticus. A new subgenus, *Rhynchomegapus*, is also described, to replace *Typanomegapus* Thor 1923, and partly based on other characters. However, no subgenerotype is designated.

C. MOTAS & (Mme) J. TANASACHI, Diagnoses de trois nouvelles Hydrachnelles phréaticoles de Roumanie, ib., 6 pp.

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Eighth contribution to the Blue Algae flora of Portugal. Descriptive list of 24 species of which *Gloeocapsa montana* Kütz., *Symploca muscorum* Gom. and *Tolypothrix fasciculata* Gom. are new for Portugal.

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